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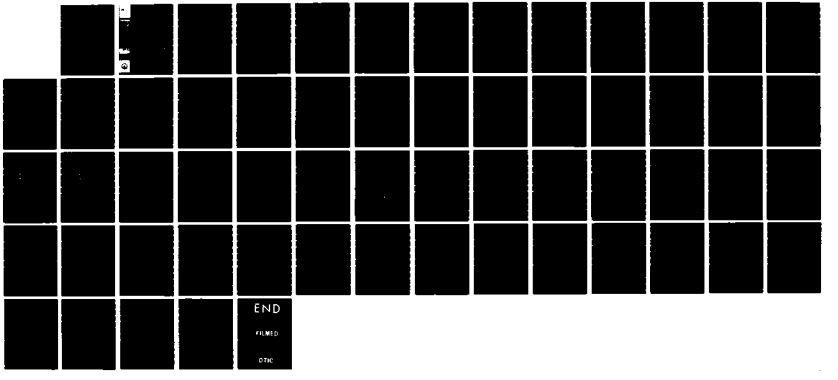

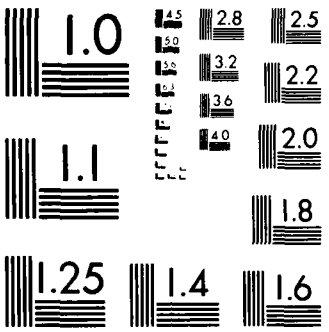

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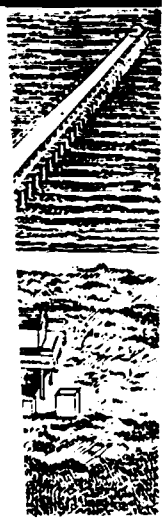

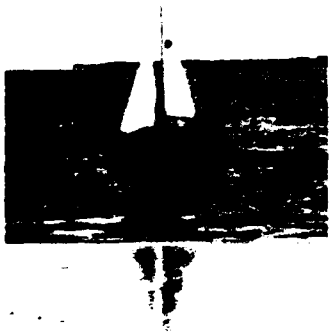

WAVE INFORMATION STUDIES OF US COASTLINES

WIS REPORT 13

SUMMARY OF ARCHIVED ATLANTIC COAST WAVE INFORMATION STUDY PRESSURE, WIND, WAVE, AND WATER LEVEL DATA

by

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September 1984
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This report is a summary of seven data sets produced and archived by the the Wave Information Study (WIS) for the Atlantic coast: (1) surface pressure fields, (2) Phase I hindcast wind fields, (3) Phase I deepwater wave data, (4) Phase II hindcast wind fields, (5) Phase II hindcast wave data, (6) Phase III nearshore wave data, and (7) water level data. The wave parameters from the data sets listed in 2, 5, and 6 have been incorporated into WIS's computer-based data system, the Sea-State Engineering Analysis System (SEAS), which is
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20. ABSTRACT (Continued).

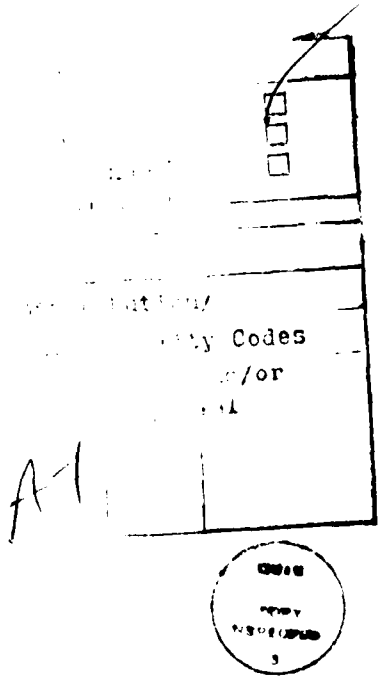
available to all Corps of Engineers personnel. These data sets, except for 1 and 7, have been transferred to the National Climatic Data Center (NCDC) in Asheville, North Carolina. These data may be obtained through Customer Service at NCDC (reference Tape Deck 9787).

PREFACE

In late 1976, a study to produce a wave climate for US coastal waters was initiated at the US Army Engineer Waterways Experiment Station (WES). The Wave Information Study (WIS) was authorized by the Office, Chief of Engineers, US Army, as a part of the Coastal Field Data Collection Program which is managed by the WES Coastal Engineering Research Center (CERC). The US Army Engineer Division, South Atlantic, and the US Army Engineer Division, New England, also authorized funds during the initial year of this study (FY 1978) to expedite execution of the Atlantic coast portion of the program.

This report, the thirteenth in a series, is a summary of the data produced and archived by the WIS for the Atlantic coast. It was prepared by Mrs. Rebecca M. Brooks and Mr. W. D. (Sam) Corson of CERC under the direction of Dr. R. W. Whalin, Chief of CERC, Mr. C. E. Chatham, Jr., Chief of the Wave Dynamics Division, and Mr. D. G. Outlaw, Chief of the Waves Processes Branch. Mr. J. H. Lockhart, Jr., Office, Chief of Engineers, is the Technical Monitor for the Coastal Field Data Collection Program.

Commander and Director of WES during the preparation and publication of this report was COL Tilford C. Creel, CE. Technical Director was Mr. Fred R. Brown.



CONTENTS

SUMMARY OF ARCHIVED ATLANTIC COAST WAVE INFORMATION STUDY

PRESSURE, WIND, WAVE, AND WATER LEVEL DATA

PART I: INTRODUCTION

1. The basic steps in the calculation of waves from past meteorological data are shown in Figure 1. First, pressure data must be assimilated into a pressure field that depicts all important synoptic weather features. Gradients

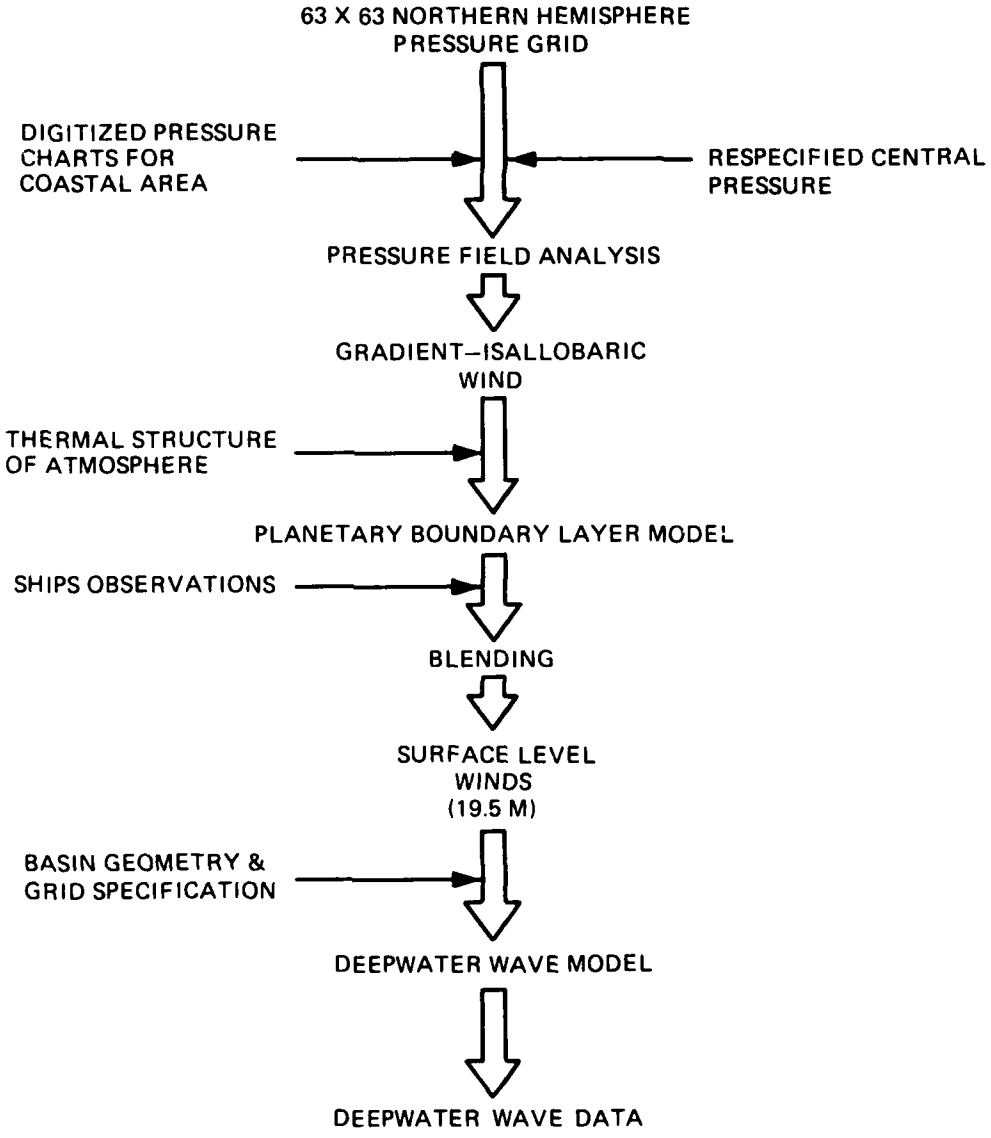


Figure 1. Schematic of hindcast production

of pressure in time and space, along with certain thermal characteristics of the planetary boundary layer, then are used to construct an estimate of a quasigeostrophic wind speed and direction at some level where it is assumed that the frictional effects of the ocean surface on the atmosphere are negligible. Next, an analysis of the vertical variation of the wind in the planetary boundary layer is used to reduce this wind to a common 19.5-m level. Finally, these surface winds are input into a numerical wave model to simulate wave generation, propagation, and decay.

2. The Wave Information Studies (WIS) for US coastlines separated the Atlantic coast wave climatology into three phases (Figure 2):

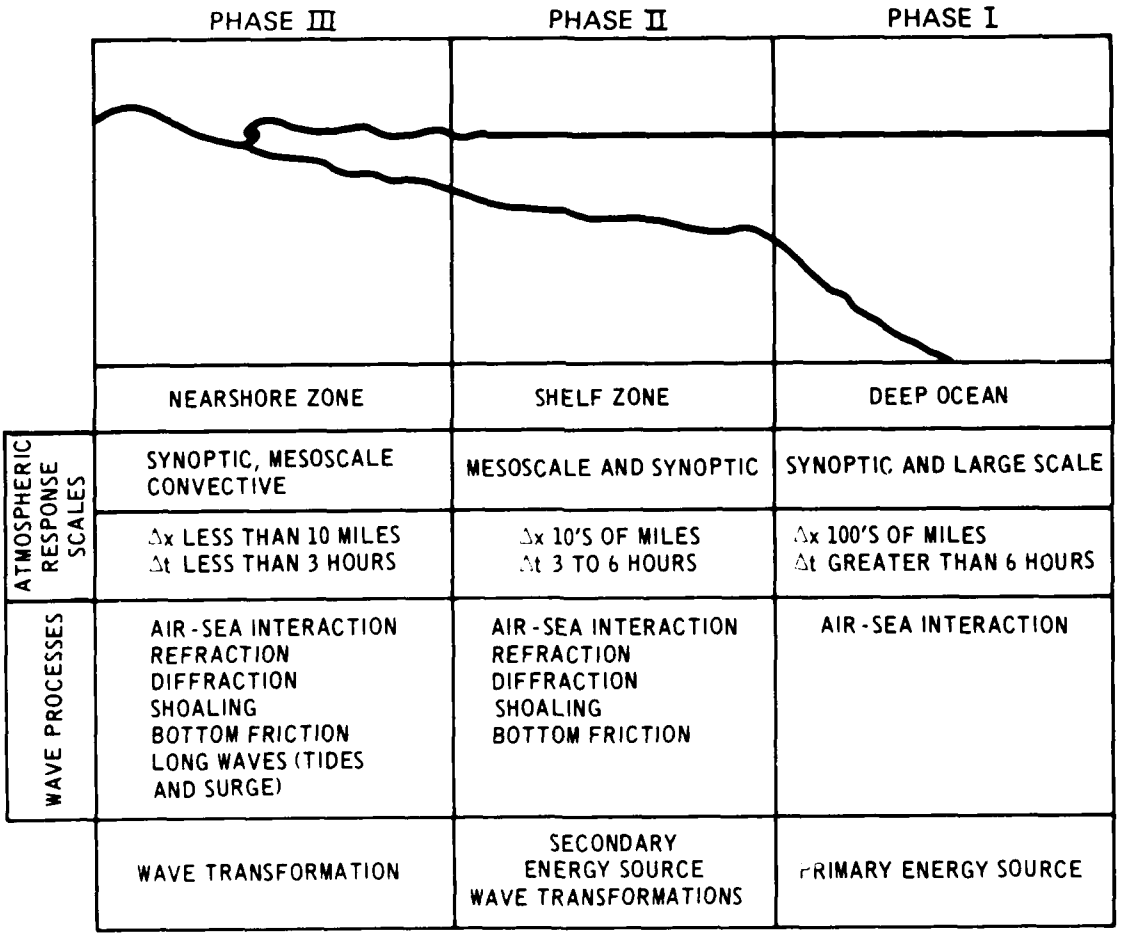


Figure 2. Conceptual diagram of the three phases of the Wave Information Study

a. Phase I - Numerical hindcast of deepwater wave data from historical surface pressure and wind data.

b. Phase II - Numerical hindcast at a finer scale than Phase I to better resolve the sheltering effects of the continental geometry. Phase I data serve as the boundary conditions at the seaward edge of the Phase II grid.

c. Phase III - Transformation of Phase II wave data into shallow water and inclusion of long waves.

Figure 2 presents a schematic of the relationships of the three phases and their approximate boundaries.

3. Since digitized surface pressure data were available for the period 1956 through 1975 when the WIS began in 1976, it was decided that the hindcast would be performed for that 20-year interval.

4. This report presents an overview of the data processed in hindcasting the wave climate for the US Atlantic coast. The data sets discussed are: (a) ships' observations,* (b) reconstructed pressure fields, (c) hindcast wind fields (Phases I and II), (d) hindcast wave data (Phases I, II, and III), and (e) hindcast water level data. The availability and formats of these data sets are summarized.

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* The procedure for processing the surface marine data detailed in this report was applied to three separate data sets, one each for the Atlantic, the Pacific, and the Gulf of Mexico. The other available data sets pertain to the Atlantic Ocean only.

PART II: SURFACE MARINE OBSERVATIONS

5. Surface marine information is the sole source for the air and sea temperature data mandatory in the definition of atmospheric thermal stability. These data, assimilated for the Northern Hemisphere, are available from the National Climatic Data Center (NCDC), National Oceanic and Atmospheric Administration (NOAA), in Asheville, North Carolina. This information, Tape Data Family 11 (TDF-11), is organized geographically using the Marsden Square Numbering System (10 deg latitude by 10 deg longitude). Three separate subsets of TDF-11 were needed to construct the ships' observations data bases for the WIS. Figures 3, 4, and 5, respectively, show the areas from which raw data were selected for the Atlantic Ocean, Pacific Ocean, and Gulf of Mexico.

6. On the original NOAA tapes there are 39 data fields for each reported observation, and 19 of these data fields were needed for the WIS. Each data set contains location information, a date-time identifier, wind velocity and direction values, sea-level pressure, and air and sea temperatures. Local sea and swell parameters were retained in the WIS data base for the Gulf of Mexico only. For the Atlantic and Pacific Oceans, sea and swell information was retrieved from the original TDF-11 tapes as required for comparisons during model verification.

7. Each set of marine data had to be reorganized with respect to time, beginning with the earliest year. The initial step in building the three chronological data bases consisted of numerous computer runs to search 265 of the 500 TDF-11 tapes for marine information available during the time period required by WIS (1956-1975). To economize space, the data from these 265 tapes were merged onto 44 reels, each containing approximately 400,000 records. Since the original TDF-11 coded format was maintained throughout this primary search, these 44 consolidated tapes required sorting with respect to time. Dates for all WIS data are referenced to Greenwich mean time (GMT).

8. The chronological sorting of the ships' observations could not be efficiently accomplished on WES's Honeywell 635 computer due to the sheer mass of data (almost 16,000,000 observations for the three water bodies) that had to be processed. The Texas Instruments Advanced Scientific Computer (TI-ASC or ASC), which was available at WES for a limited time, had the capacity to accommodate this extremely large-scale data processing. Therefore, each of the consolidated tapes had to be converted to formats compatible with the ASC.

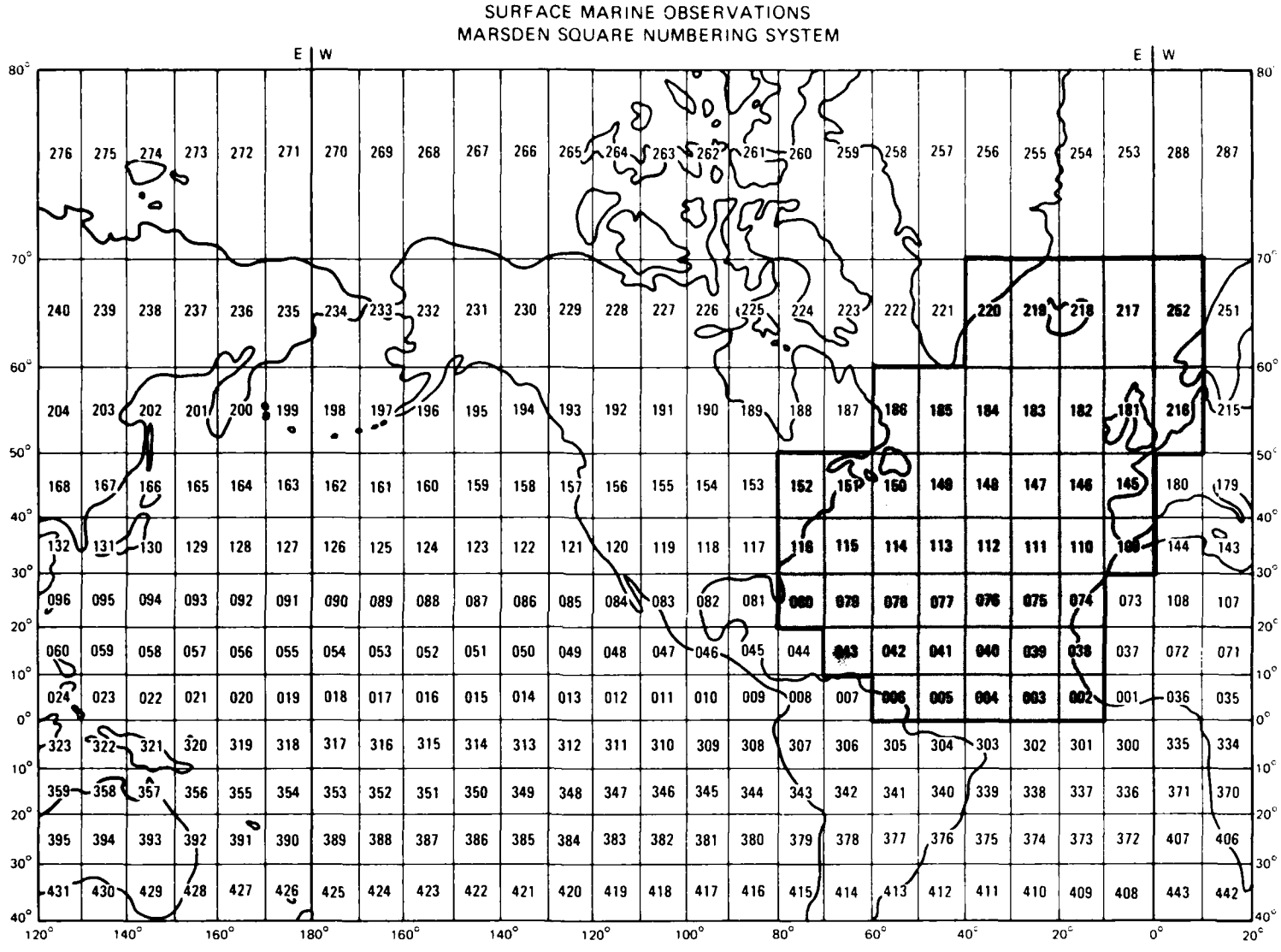

Figure 3. Marsden Squares (TDF-11) surface marine observations used for Atlantic Ocean data base

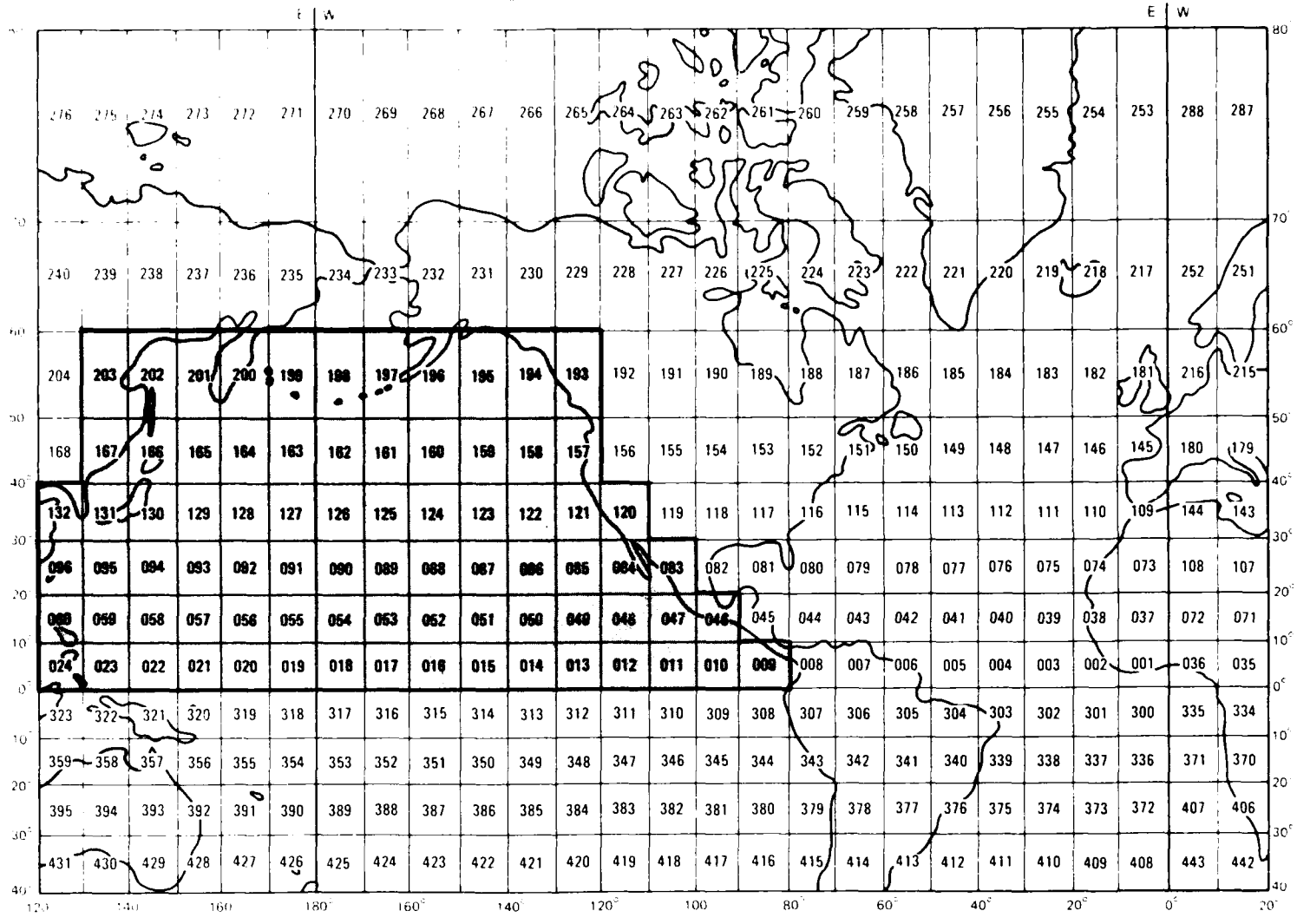

Figure 4. Marsden Squares (TDF-11) surface marine observations used for Pacific Ocean data base

PHASE VI: PHASE II HINDCAST WAVE DATA

23. As with Phase I, Phase II wave data were generated by numerical simulation of wave growth, propagation, and decay for historical wind fields. Phase II calculations were performed as an intermediate step between the Phase I hindcast and the Phase III nearshore wave transformations to provide a better representation of the effects of coastline geometry on wave generation near the Atlantic coast. Also, refraction and shoaling effects were included for those points which lie in water depths less than 100 m. Both of these factors can combine to produce significant changes in wave conditions in embayed and sheltered areas along the Atlantic coast. Without proceeding through the full Phase II calculations, such effects could have only been treated as heuristic or empirical modifications to the Phase I data before initiating the Phase III nearshore wave transformations.

24. The Phase II wave hindcast calculations were performed on the SOG with points four times as dense as the 31 by 31 grid used for Phase I. Phase I data were used as boundary conditions for Phase II. Figure 12 shows the limit of the Phase II calculations and all locations for which the hindcast wave information is retained on magnetic tape. Several data processing and analysis programs were employed to create the 20-year (1956-1975) geographically oriented parameter tapes for the 73 locations (Table 4) along the Atlantic coast. In order to maintain a workable report size, the analyses of 33 of the 73 Atlantic coast Phase II stations were selected for publication in Corson, et al., 1982 (Figure 13). Each three-hour synoptic record contains wind speed and direction* values in addition to the simple wave characteristics that describe the local sea and swell. The six parameters for each time-step (height, period, direction for local sea and swell) are recorded as described for the processed Phase I hindcast wave data (Part V, paragraph 21).

25. The unlabeled points in Figure 12 indicate locations for which Phase II hindcast wave data exist, but only in the unprocessed form (packed format) as they were produced by the wave model. The first-form

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* The value of the wind direction is the direction toward which the waves are traveling as shown in Figure 9. The angles are measured counterclockwise with 0 deg as due east. Conversion instructions for finding azimuth values for directions from which waves come are detailed in Figure 9.

22. The 20-year parameter data set for each of the 13 Phase I locations has been transferred to NCDC and incorporated into their master library. These data may be obtained through Customer Service at NCDC (reference Tape Deck 9787). Corps of Engineers personnel can access these wave data for site-specific calculations by way of the Sea-State Engineering Analysis System (SEAS) (Ragsdale 1983).

for the 20-year period of 1956 through 1975. These first-form (unprocessed) tapes are monthly data tapes containing the two-dimensional spectra (16 direction bands and 20 frequency bands) for the selected locations (Figure 11) and wave parameters calculated from the spectral data. These spectra are first-form data and need to be serially processed and analyzed. This data set is archived at WES for future reference.

21. Although wave data were hindcast for locations throughout the Atlantic, the data from 13 locations (stations) were selected for analysis and publication, since primary interest was in the area adjacent to the US Atlantic coast (Figure 11 and Table 3). Initial processing required the separation of local sea and swell information from the total energy represented in the two-dimensional spectrum calculated by the wave model. This time-oriented data base for the 13 selected stations was then reorganized with respect to geographic location. Several FORTRAN programs were employed to finalize the 20-year record (1956-1975) of hindcast, deepwater, significant wave data (height, period, and direction) for each of the 13 Atlantic coast stations. Since a deepwater wave model was used to calculate the results (Corson et al. 1981), all wave parameters represent deepwater conditions. In the cases where the actual grid point location is in shallow water, the data should be regarded as estimates for a point farther offshore in deep water. Six parameters describing simple wave characteristics (height, period, and direction for local sea and swell) are recorded for each synoptic time-step (three-hour intervals). The significant wave height (H_s) analyzed represents the combined sea and swell; that is, the square root of the sum of the squares of the sea and swell significant wave heights

$$H_s = \sqrt{H_{sea}^2 + H_{swell}^2} \quad \text{or} \quad 4\sqrt{\text{total energy}}$$

The "sea" periods and directions* are the average periods and directions for waves in the "sea" region of the spectrum; and similarly, the "swell" periods and directions are the average periods and directions for waves in the "swell" region for the spectrum.

* The value of the wave direction is the direction toward which the waves are traveling as shown in Figure 9. The angles are measured counterclockwise with 0 deg as due east. Conversion instructions for finding azimuth values for directions from which waves come are detailed in Figure 9.

PART V: PHASE I DEEPWATER WAVE DATA

20. Phase I wave data were produced by numerical simulation of wave growth, propagation, and decay for historical wind fields at points in a SOG which cover the North Atlantic Ocean (Resio 1982, Resio and Tracy 1983). Figure 11 shows all locations for which hindcast, deepwater, significant wave information is retained on magnetic tape. The unlabeled points indicate locations for which Phase I wave data exist, but only in the unprocessed form (packed format) as they were generated by the wave model. These data are stored at three-hour intervals

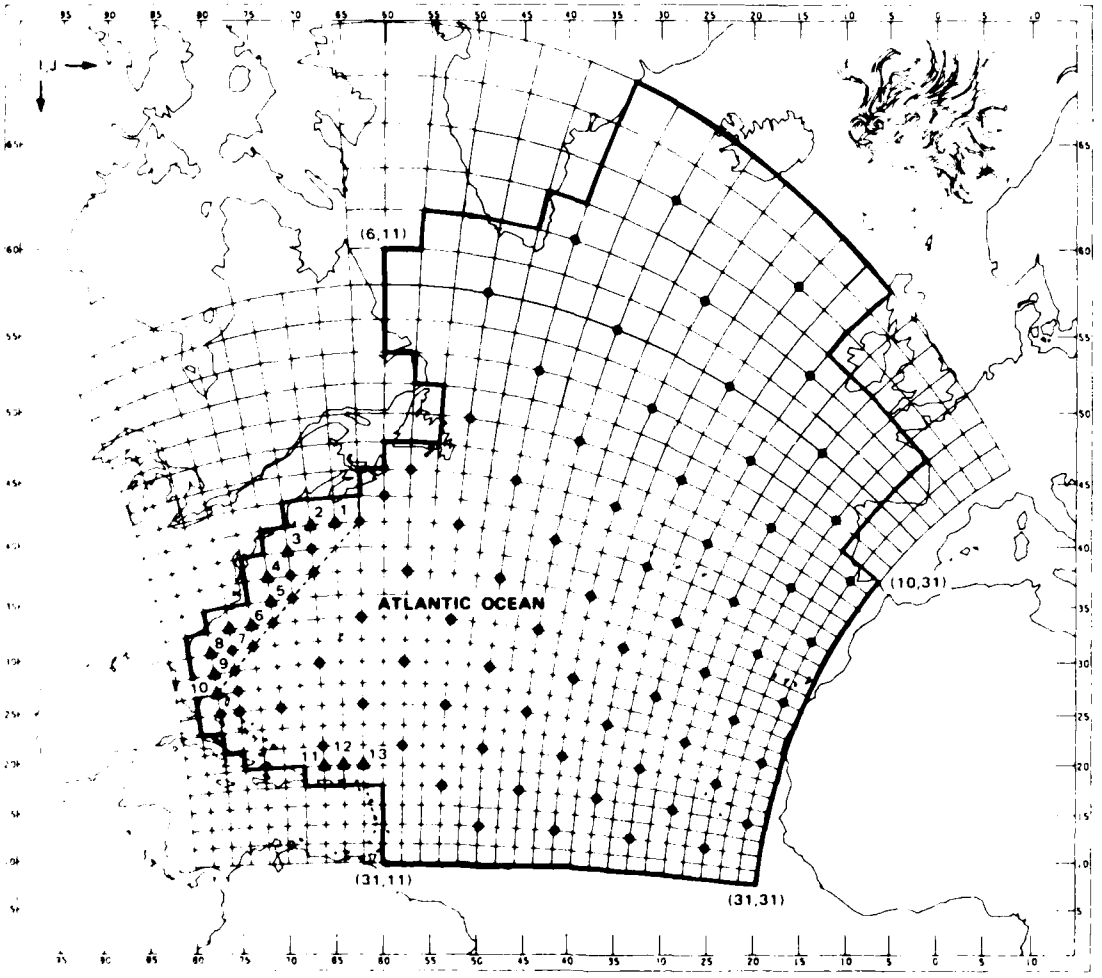

Figure 11. Atlantic Phase I SOG showing all locations for which first-form hindcast, deepwater, significant wave information is retained on magnetic tape. Numbered points indicate sites for which wave data were published

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PART IX: SUMMARY

33. The objective of ACWIS was to provide the US Army Engineers (USAE) with hindcast wave and water level information for the US Atlantic coast. This report shows that additional valuable information has been produced as part of the WIS working toward its goal. The procedures used and the data produced have been presented previously in several WIS reports. Since many of the details of the data processing for the WIS are not included in this summary report, reports listed in the references and bibliography should be reviewed for a more complete understanding of the WIS. The ACWIS has produced and archived extensive surface pressure data and open-ocean wind data as well as hindcast wave and water level information. All data produced by the ACWIS are summarized in Table 7.

34. In addition to WIS data reports (Corson et al. 1981, Corson et al. 1982, Ebersole 1982, and Jensen 1983a), the Atlantic hindcast wave data have been archived for the USAE on the computer-based data system. SEAS has been updated with deepwater wave data from the Pacific Ocean and in the near future will be extended to include shallow-water wave transformations.

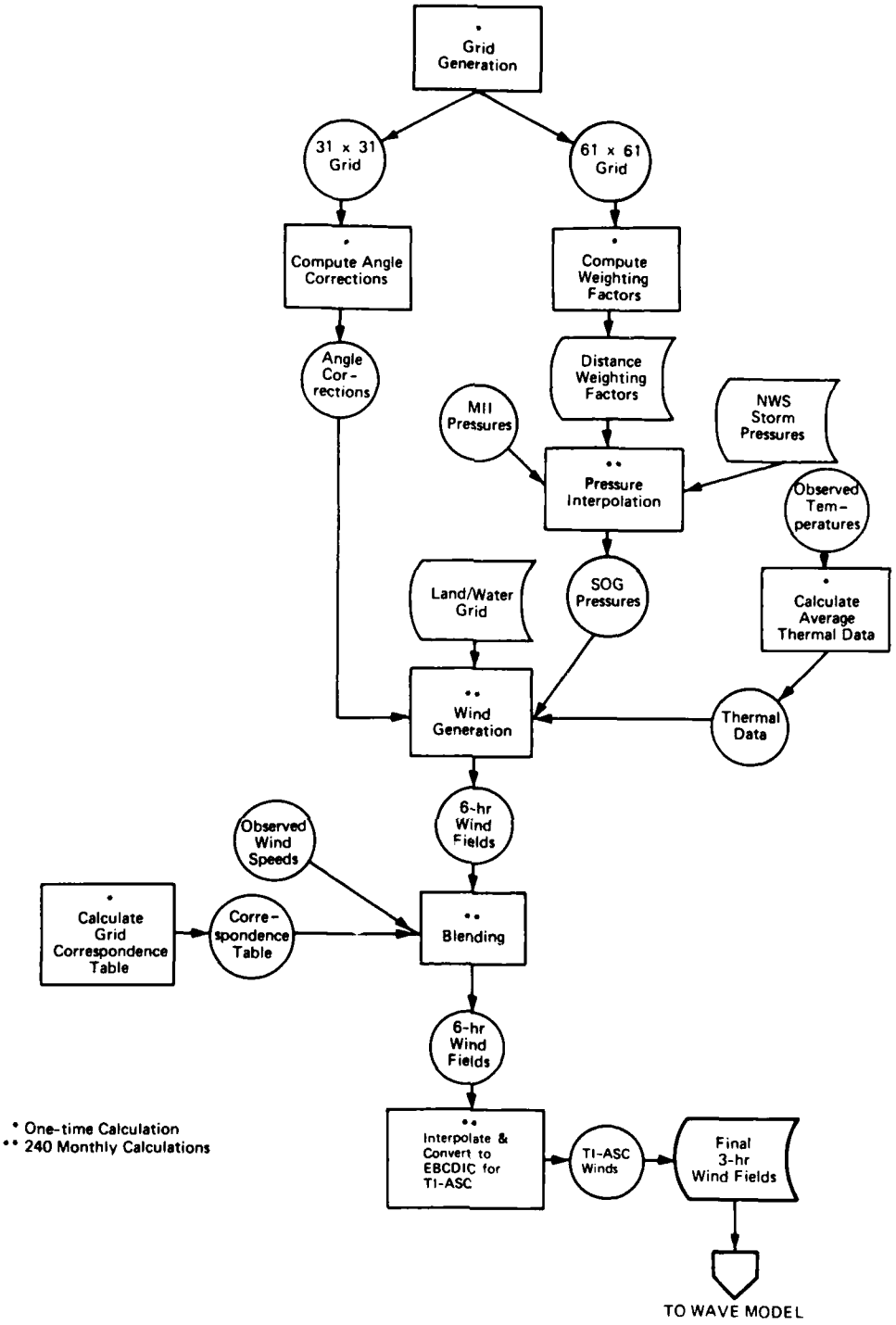

Figure 8. Processing system for Atlantic Phase I hindcast wind fields

the 31 by 31 SOG for the Atlantic Ocean (Figure 7). Table 1 lists the latitude-longitude coordinates for each intersection point on the Atlantic Phase I SOG. A flow chart which summarizes the WIS numerical wind model and blending programs is provided in Figure 8. The wind velocities and directions are integer values recorded in knots and degrees, respectively. The value of the wind direction is the direction toward which the wind is blowing, as shown in Figure 9. The angles are measured counterclockwise with 0 deg as due east. Conversion instructions for finding azimuth values for directions from which the winds are blowing are detailed in Figure 9.

18. The 20 years of Phase I hindcast winds have been transferred to the NCDC. These data may be obtained through Customer Service at NCDC (reference Tape Deck 9787). These data also have been retained on magnetic tapes stored at WES.

19. The wind fields for the Phase II portion of the ACWIS were calculated on a SOG four times as dense as the Phase I grid. These winds fields were created via the Phase I interpolated (three-hour) winds. Phase I values occurring at every other time-step (six-hour intervals) were used to calculate the Phase II wind fields on the 4x-grid. These six-hour wind fields were augmented by blending in ships' observations at the finer grid scale. The final Phase II velocities and directions were interpolated to three-hour time-steps. Figure 10 shows the area of the Phase II grid (41 by 33) for which these interpolated wind fields are available. Table 2 lists the latitude-longitude coordinates for each intersection point on the Atlantic Phase II SOG. NCDC also has integrated these Phase II wind fields into their Tape Deck 9787. Auxiliary copies of tapes containing this data set have been archived at WES.

PART IV: PHASE I AND PHASE II HINDCAST WIND FIELDS

14. An integral part of the ACWIS 20-year wave hindcast was the reconstruction of surface wind fields from available historical meteorological data. Three primary sources of information were used during the reconstruction of these wind fields:

a. Gridded Northern Hemisphere pressure fields (Holl and Mendenhall 1971) (as discussed in Part III).

b. North American Historical Weather Map Series (available from NCDC).

c. Surface marine observations (TDF-11 available from NCDC).

15. Basically, two independent types of information in the three data sets were considered--pressures and winds. First, the pressure data were converted by means of an analysis of pressure gradients into estimates of quasi-geostrophic winds. Then, these approximations were transformed into estimates of wind vectors at a reference level of 19.5 m above the surface (Resio, Vincent, and Corson 1982). After the geostrophic-level winds were reduced to near-surface winds, independent observations from ships (c of above, as discussed in Part II) were blended into the wind fields. The procedure used was simply to average the observed wind speed with the nearest grid point wind speed. Although more sophisticated methods were considered, the effects due to differences in storm position seemed to offset any potential gain inherent in a more elaborate methodology. Wind directions from ships were not blended into the wind fields since a 180-deg direction error can be quite common due to the manner in which the values are coded. Over the 20-year period for which calculations were made, approximately 7.4 million ships' observations were averaged into the final wind fields. These hindcast wind fields are representative of open-ocean winds.

16. The grid on which the surface wind fields were calculated was generated by latitude/longitude values computed in a coordinate system of great circle paths for quasi-east/west lines and orthogonals to the great circle paths for quasi-north/south lines. Use of a SOG resulted in great circle paths for wave propagation into the east coast of the United States, the principal area of concern in this study.

17. The hindcast wind fields used as input to the Phase I numerical model were computed at three-hour intervals for each intersection point on

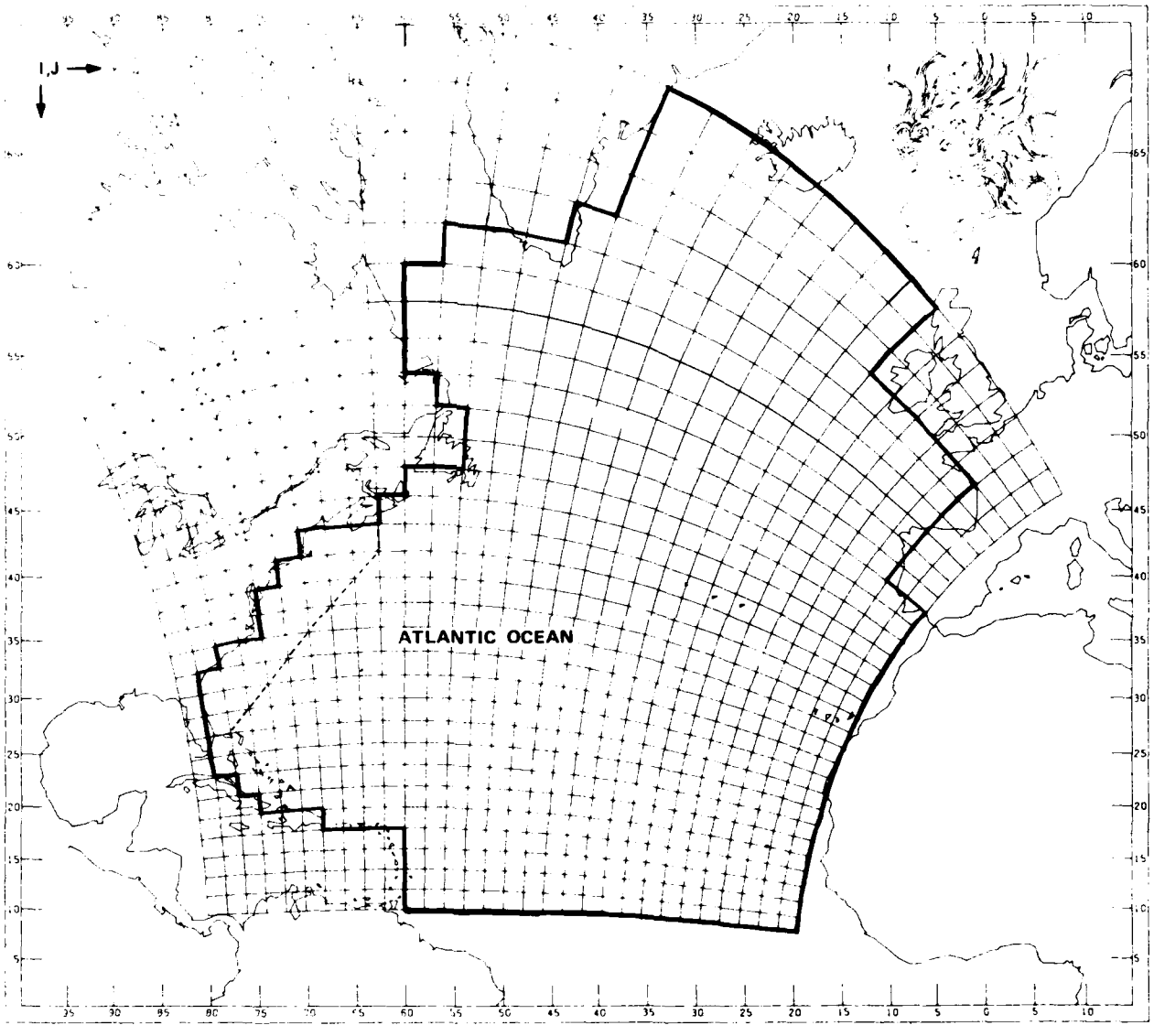

Figure 7. Phase I SOG for Atlantic Ocean. Heavy line indicates boundary for numerical calculations

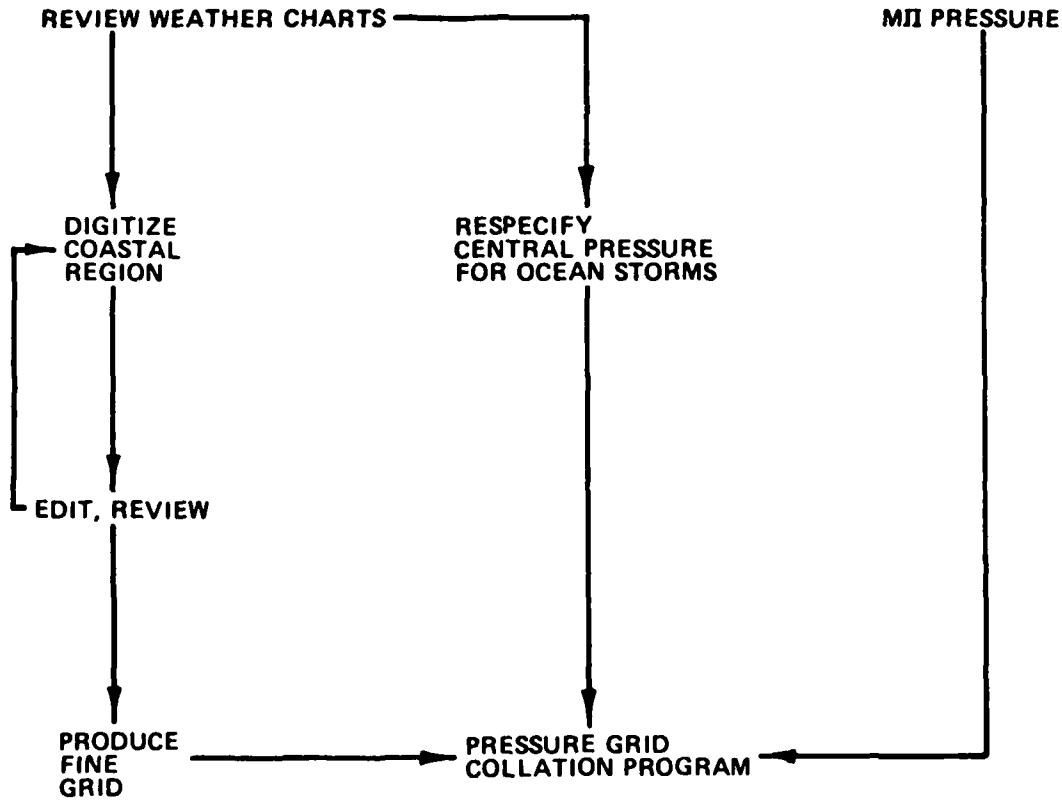

Figure 6. Pressure field development procedure

PART III: SURFACE PRESSURE FIELDS

12. For the Atlantic Coast Wave Information Study (ACWIS), two sources of sea-level pressure data were used to develop a valid pressure field for wave hindcasting purposes. The fundamental information was supplied by Meteorology International, Inc., (MII) with supplemental data taken from National Weather Service (NWS) synoptic surface charts. After extensive comparisons, it was determined that the MII pressure fields did not suffice for a synoptic-scale representation of pressure gradients. The pressure field developed from MII data usually is not as intense as the NWS pressure field in areas with steep pressure gradients (Corson, Resio, and Vincent 1980). Consequently, input wind fields for the numerical hindcast model could not be adequately computed. Considerable effort was expended to find the most efficient method to reconstruct accurate pressure fields for the ACWIS. It was decided that the NWS pressure field would be digitized and that this digitized information would be overlaid on the MII data, with blending on the edges to achieve continuity between the two fields (Corson, Resio, and Vincent 1980). Figure 6 outlines the steps taken to produce the ACWIS pressure fields.

13. The resulting pressure fields used in the development of input wind fields for the Atlantic Ocean wave hindcast are stored on magnetic tape in the WES tape library. Pressure data are available at each intersection point on a 61 by 61 spherical orthogonal grid (SOG) which is approximately twice as dense as the 31 by 31 Phase I Atlantic grid (Figure 7). The synoptic observations, recorded at six-hour intervals, are arranged chronologically beginning in 1956 through 1975 with six months of data per tape. Each semiannual tape contains approximately 720 Atlantic SOG pressure fields.

9. After the data were accessible on the ASC, the major effort of reorganizing these data was addressed. The initial step in this reorganization procedure involved spawning the geographically-oriented data from each consolidated reel onto 20 reels, each containing one year's data. This step was repeated until all raw data from the 44 original tapes were contained on 20 yearly tapes. Before each year's data were sorted chronologically for the last time, a quality check was employed to validate that each of the 20 yearly tapes contained only one year's data.

10. At this point, the ships' observations needed in the production of the WIS pressure fields and wind fields were contained on 20 individual tapes. Except for the date fields, the parameters on these tapes were still recorded in coded formats as the original TDF-11 data. Due to this coding, the air and sea temperature fields contained special characters created by multipunch sign storage. The final step of processing checked for and interpreted these special characters on each of the 20 tapes. The parameters in the remaining data fields conform to the original TDF-11 coded formats.

11. The period of interest for the WIS hindcast was the 20 years from 1956 through 1975. The period of record for the WIS ships' observations data begins in 1950 but ends in 1974, due to the unavailability of 1975 data at the time the original TDF-11 tapes were purchased. The final chronological ships' observations data for the Atlantic, Pacific, and Gulf WIS are stored on digital computer tapes in the WES tape library.

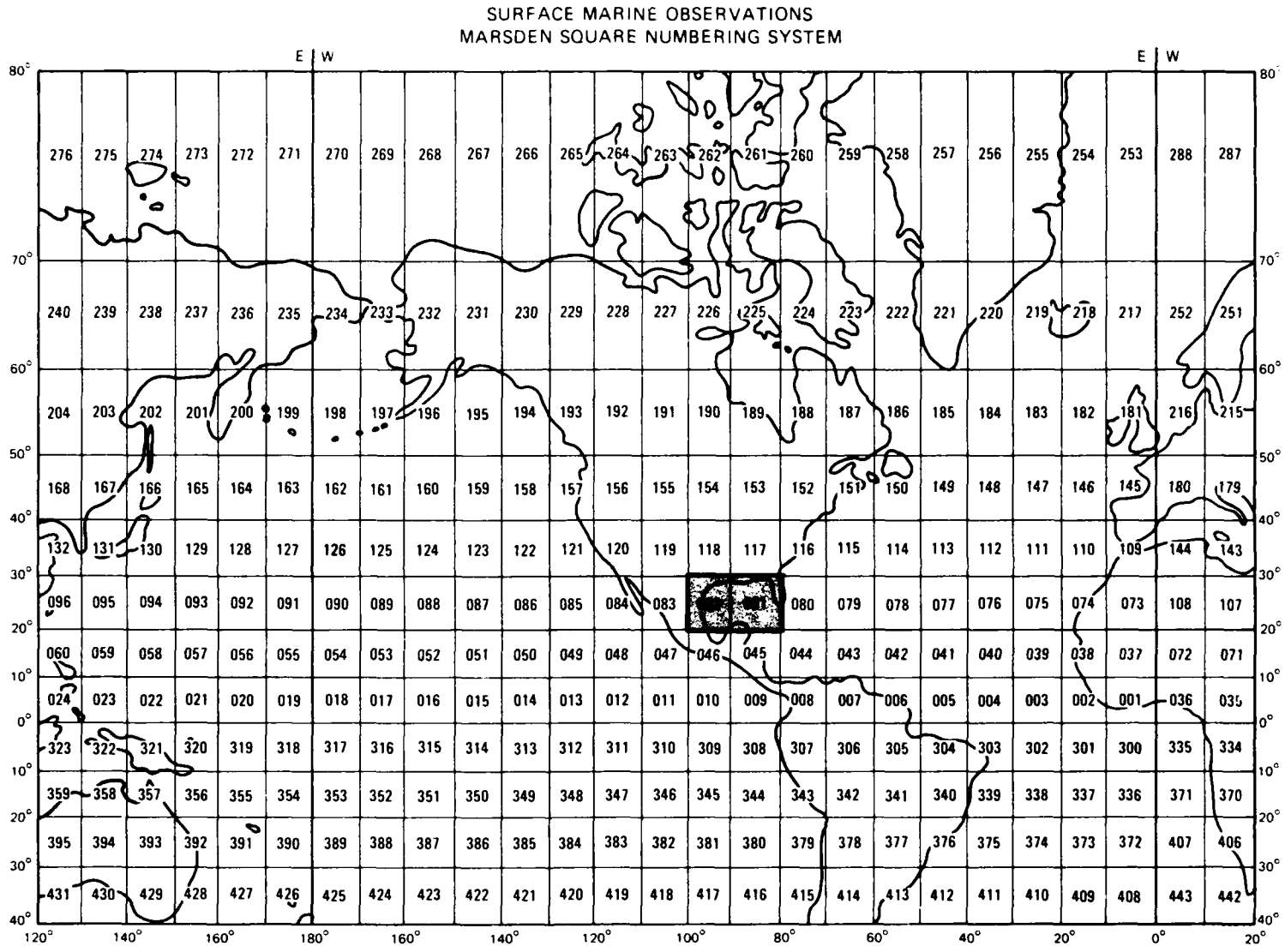

Figure 5. Marsden Squares (TDF-11) surface marine observations used for Gulf of Mexico data base

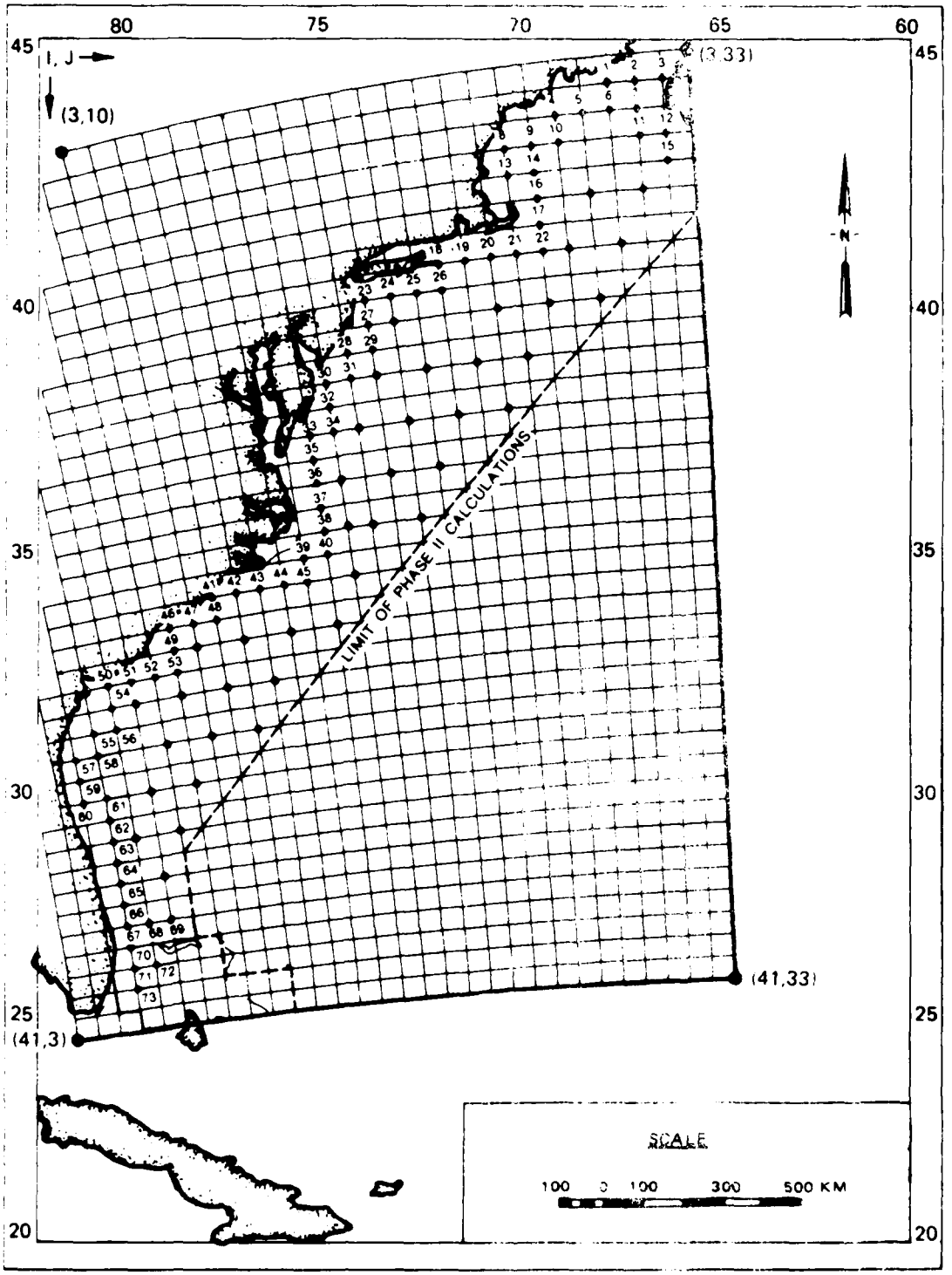

Figure 12. Atlantic Phase II SOG showing all locations for which first-form hindcase wave information is retained on magnetic tape. Numbered points indicate sites for which wave data were processed

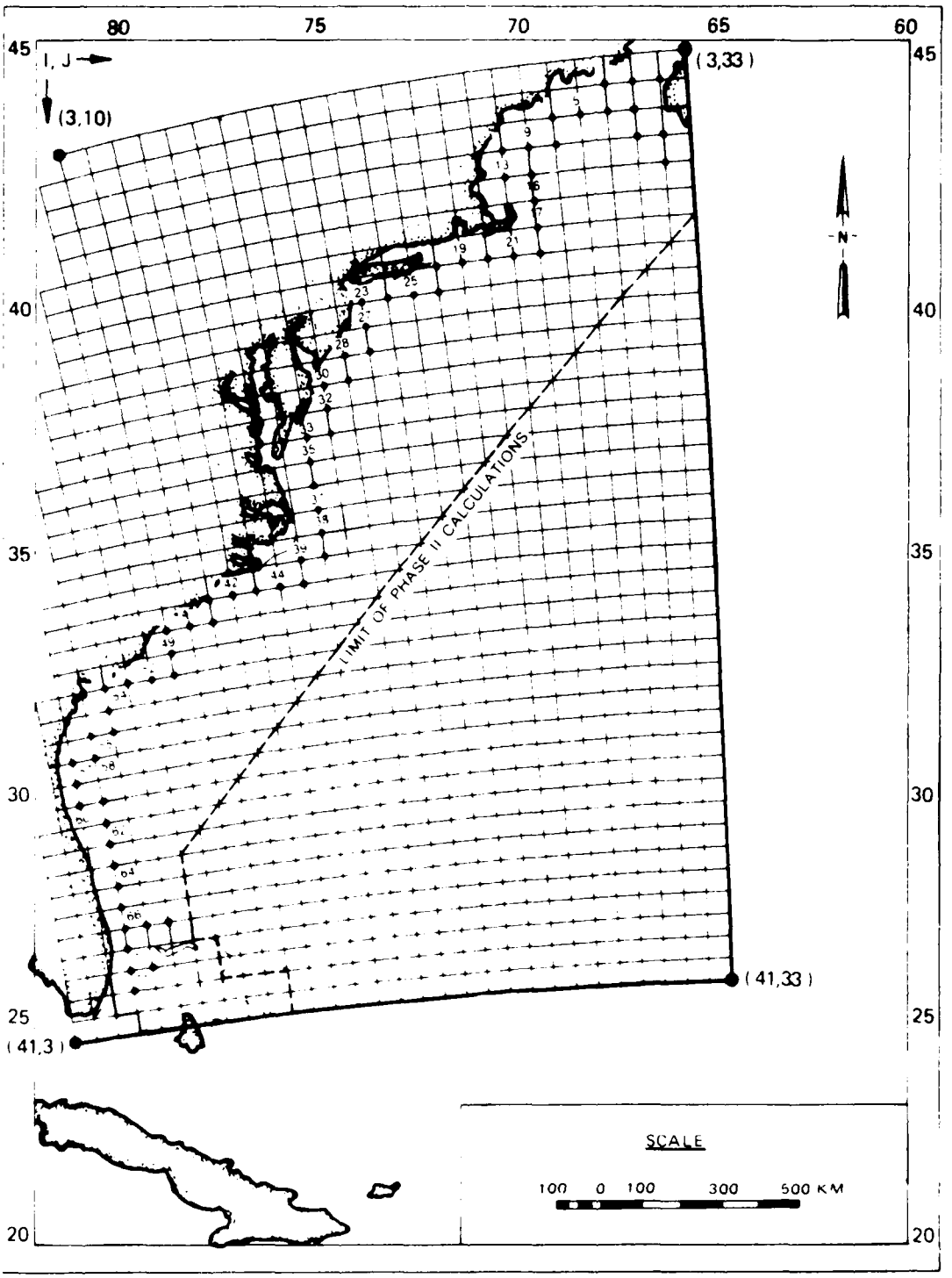

Figure 13. Atlantic Phase II SOG showing the 33 sites for which wave data are published

two-dimensional spectra (16 direction bands and 20 frequency bands) for all Phase II points are archived at WES for future reference.

26. The 20-year parameter data set for each of the 73 Phase II locations has been transferred to NCDC and incorporated into their master library. These data may be obtained through Customer Service at NCDC (reference Tape Deck 9787). Corps of Engineers personnel can access these wave data for site-specific calculations by way of the SEAS (Ragsdale 1983).

PART VII: PHASE III NEARSHORE WAVE DATA

27. For the 166 Phase III segments along the US Atlantic coast, Phase II wave data were transformed into wave data at a constant depth of 10 m (Figures 14-19 and Table 5). As with Phases I and II, these shoreline sections of coast have 20 years (1956-1975) of hindcast significant wave data (height, period, and direction) stored at three-hour intervals (Jensen 1983a, 1983b). The directions computed in Phase III are referenced to the local shoreline (Figure 20). Since the wave directions are relative to the shoreline orientation, shoreline

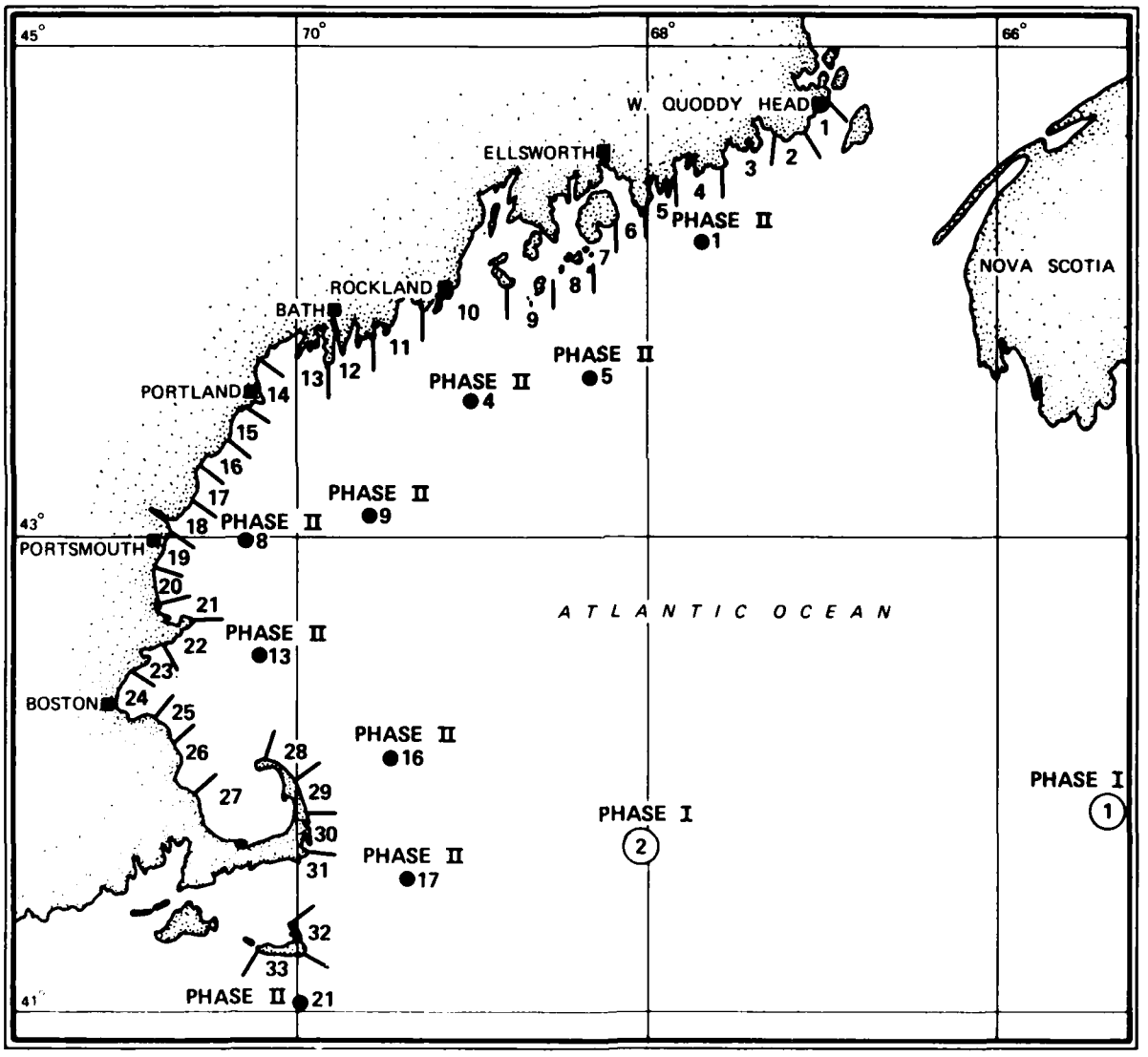

Figure 14. Locations of Phase III stations for shallow-water wave information along the Atlantic coast, Region 1

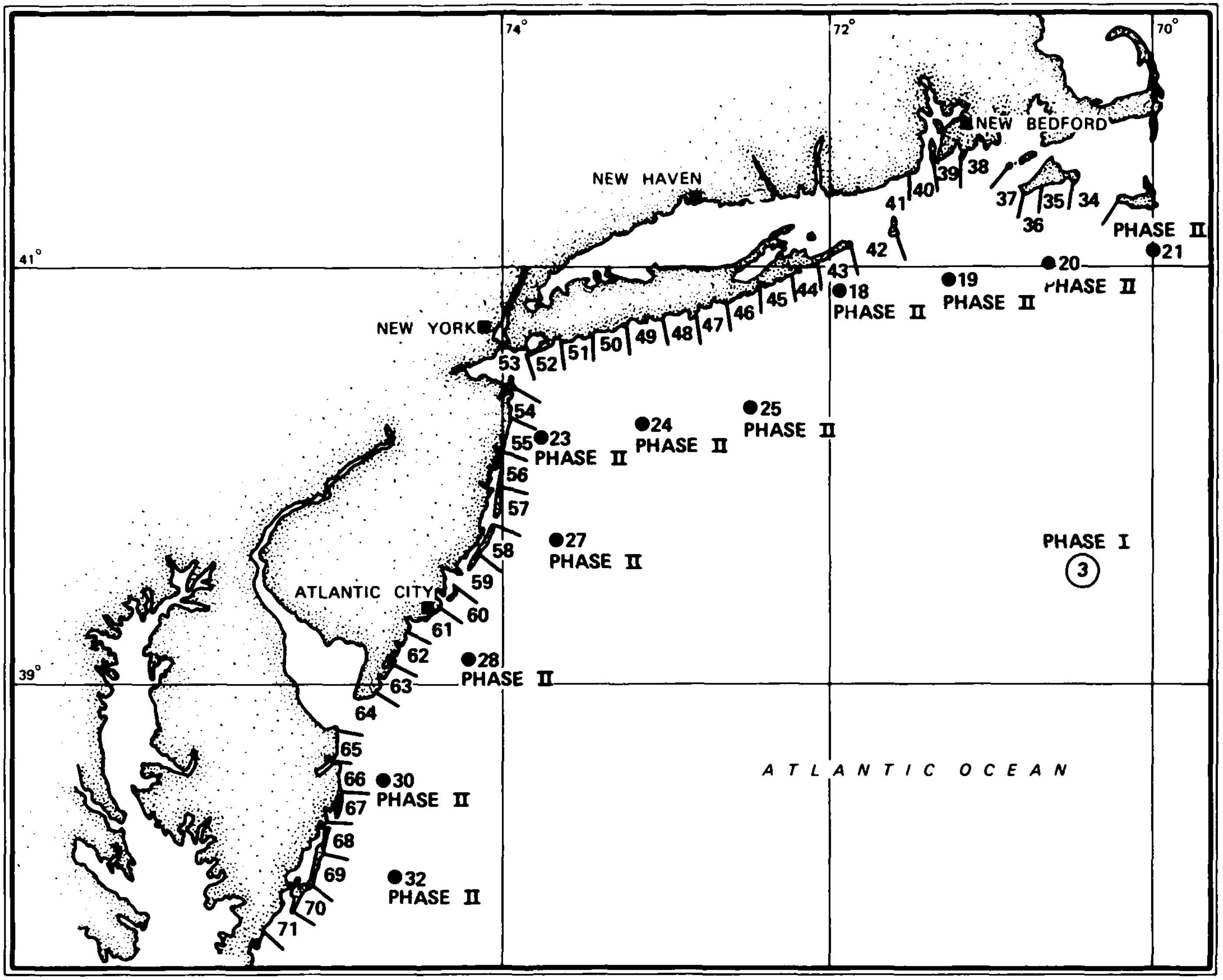

Figure 15. Locations of Phase III stations for shallow-water wave information along the Atlantic coast, Region 2

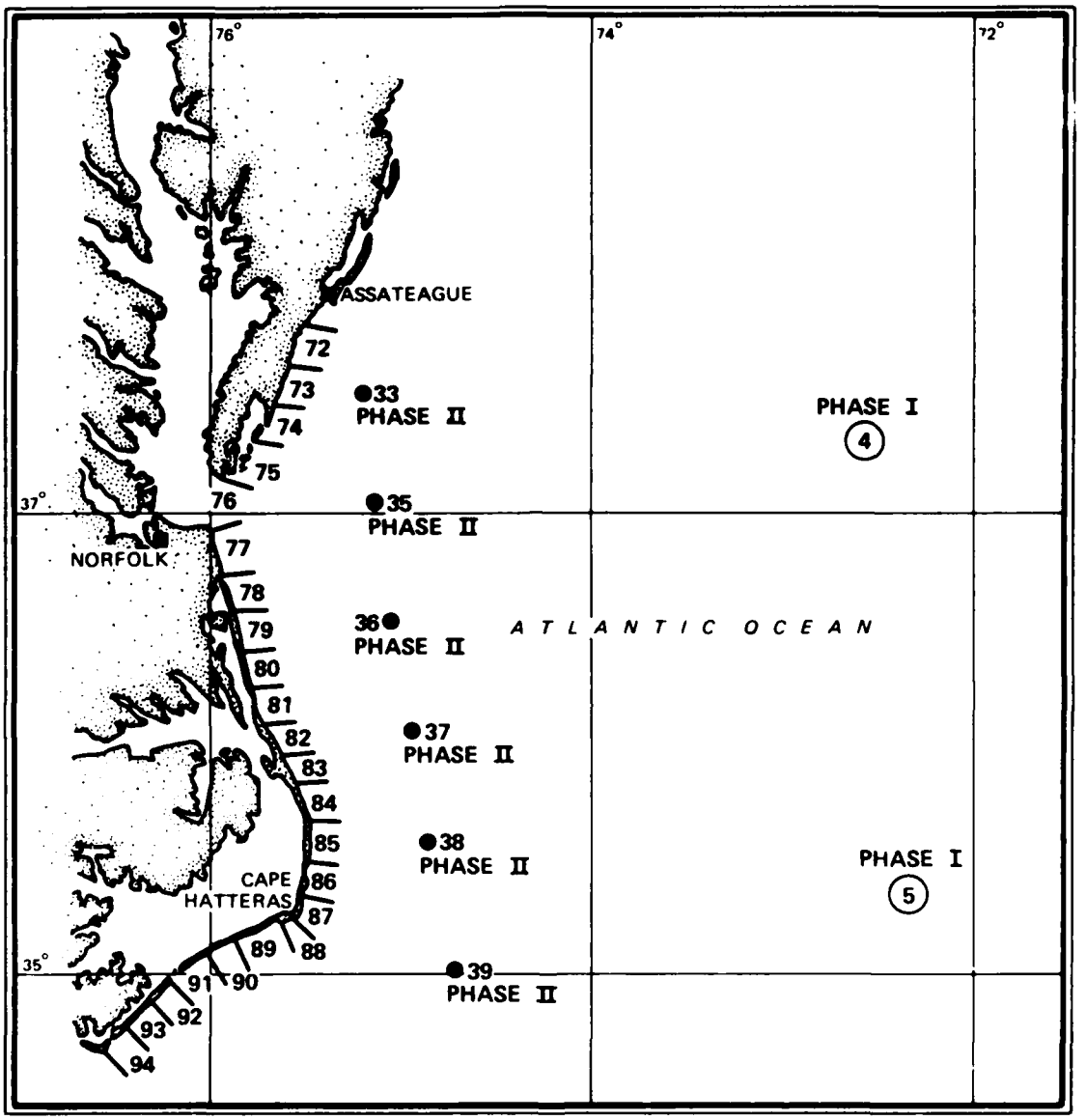

Figure 16. Locations of Phase III stations for shallow-water wave information along the Atlantic coast, Region 3

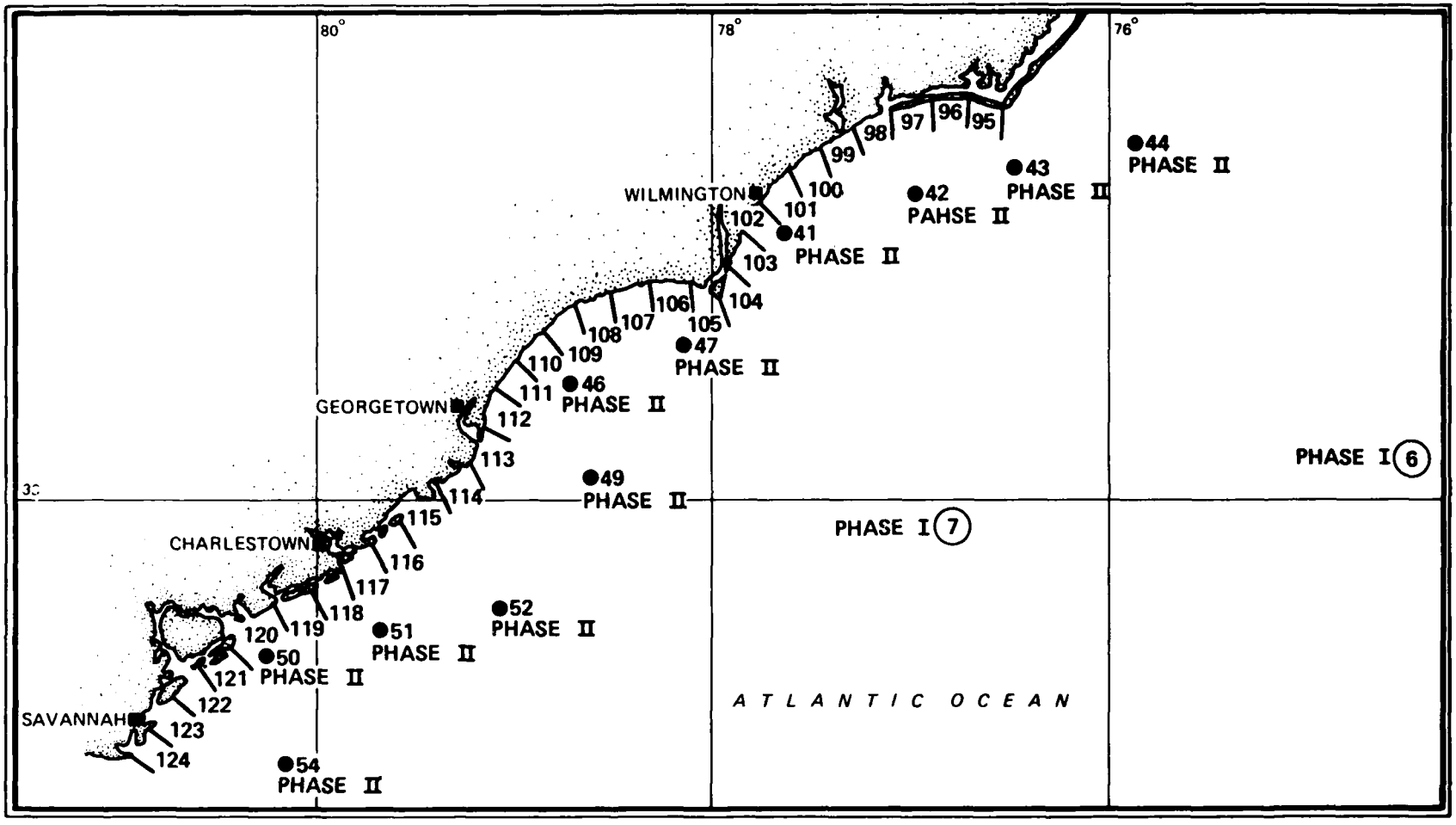

Figure 17. Locations of Phase III stations for shallow-water wave information along the Atlantic coast, Region 4

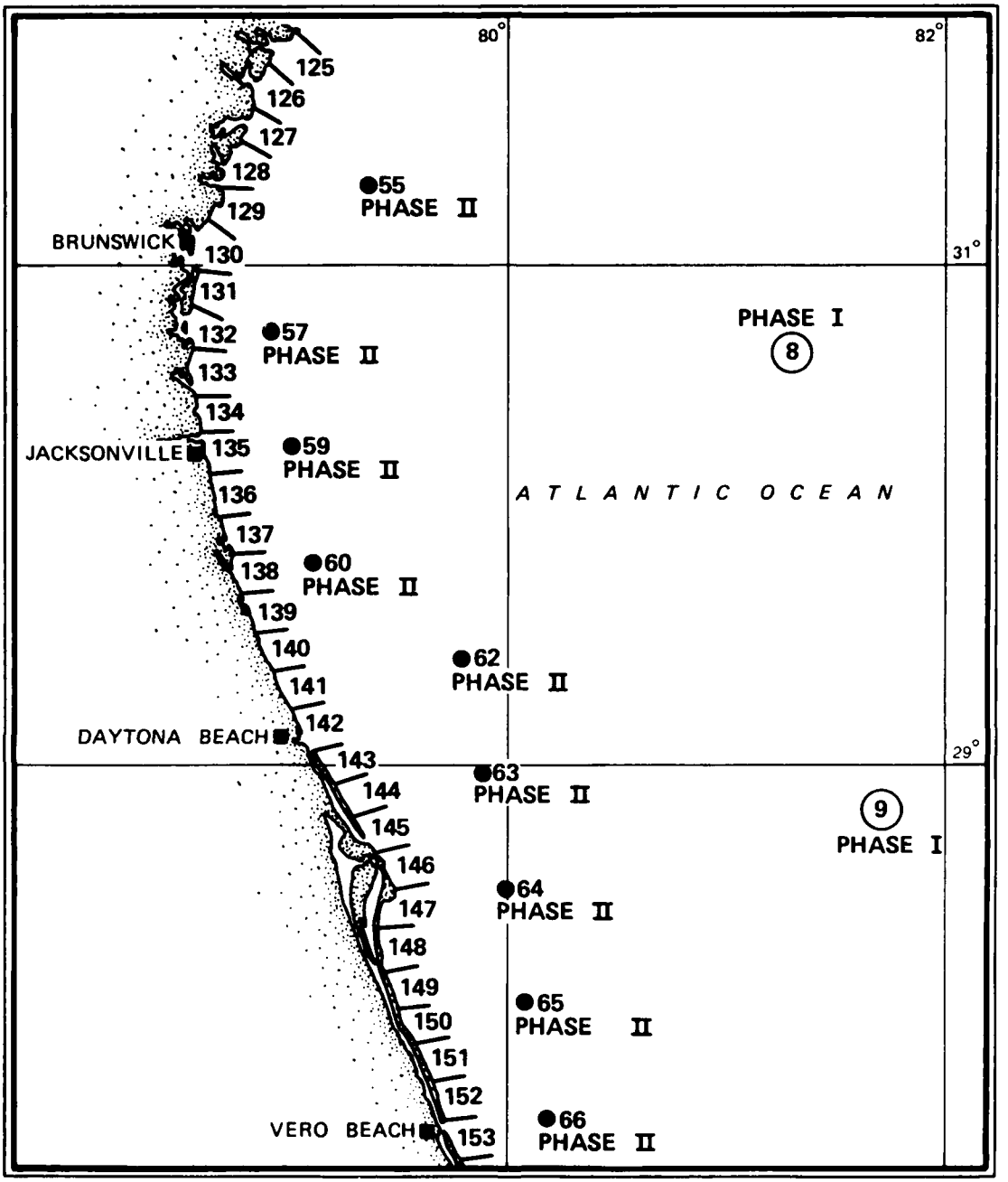

Figure 18. Locations of Phase III stations for shallow-water wave information along the Atlantic coast, Region 5

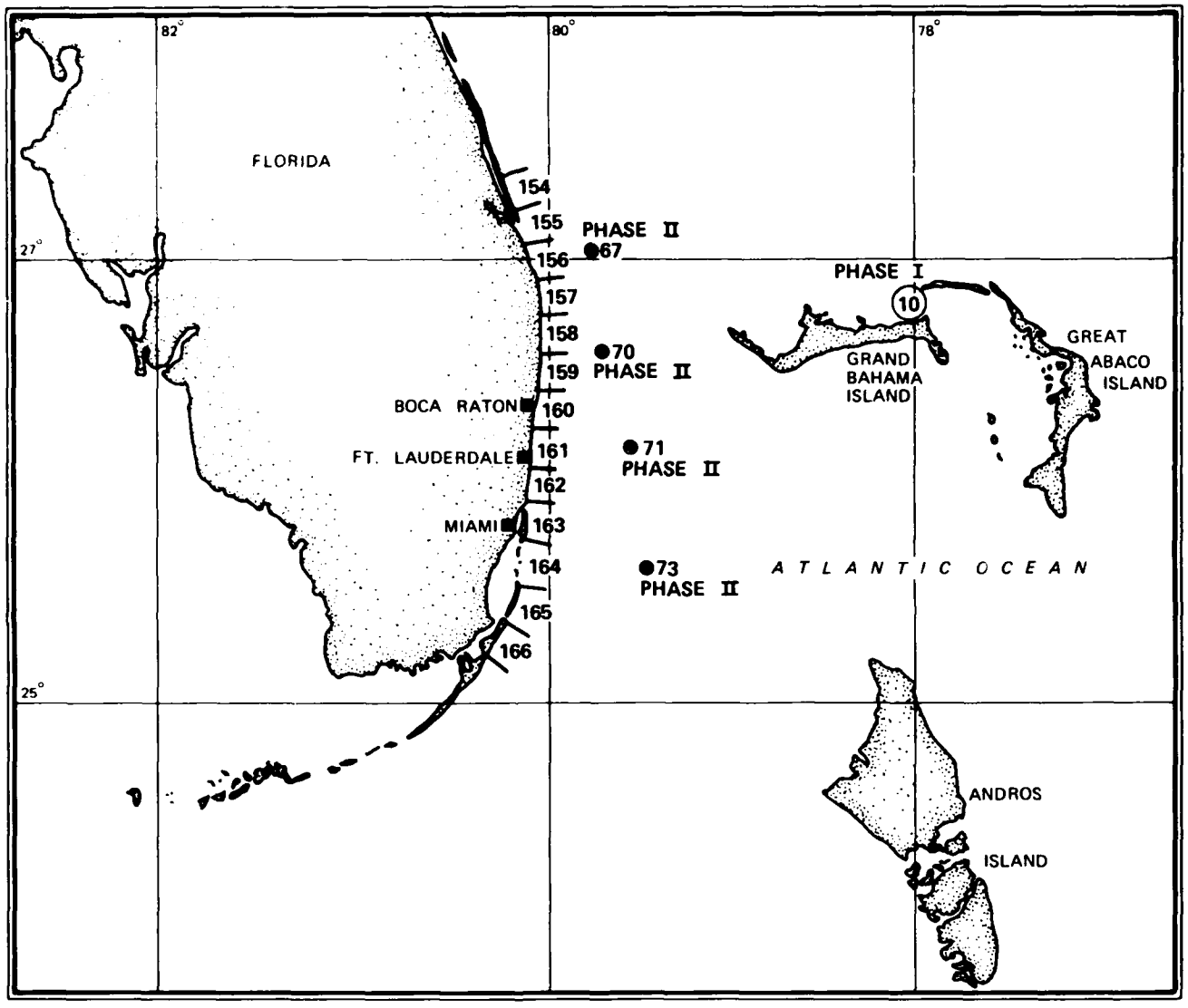

Figure 19. Locations of Phast III stations for shallow-water wave information along the Atlantic coast, Region 6

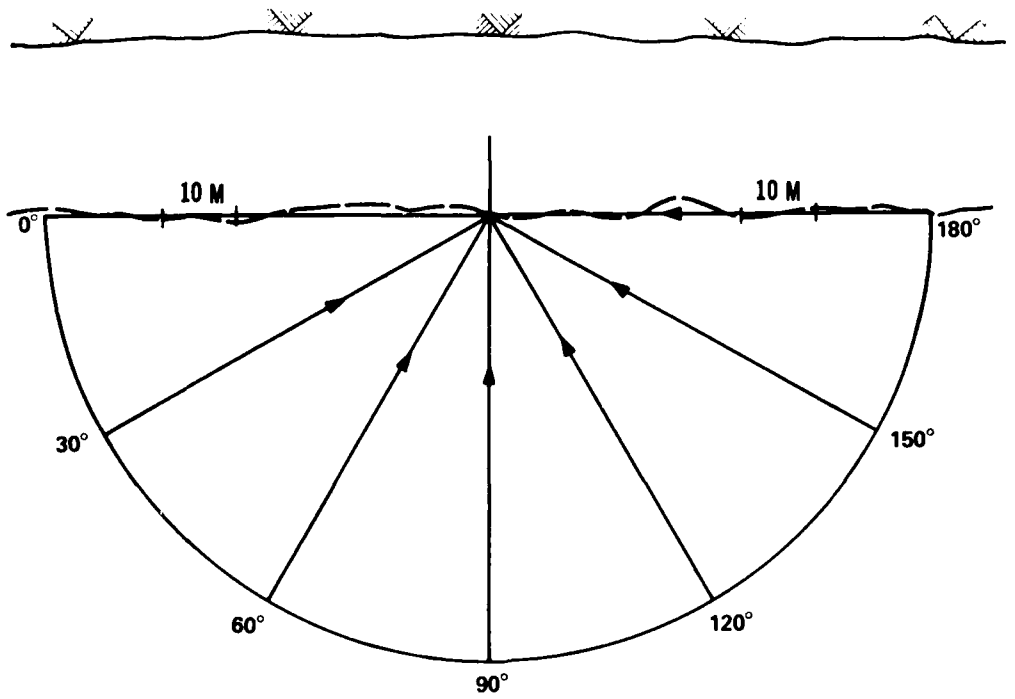

Figure 20. Classes of wave angle directions for Atlantic Phase III stations

angles (referenced to north) are provided for each Phase III shoreline section with the wave parameters (Figure 21). During the computations, differences in wave characteristics caused by fluctuation in water depth (due to tides and surges) were neglected. The Phase III wave data were generated assuming straight and parallel bottom contours, and no additional energy sources were added to existing Phase II wave conditions.

28. There were two basic steps in the calculation of the shallow-water wave climate (Jensen 1983b). First, the given Phase II sea wave parameters (height, period, and direction) were used to construct a two-dimensional (frequency and wave direction) discrete spectrum. Only the energy bands (in the directon space) that were within ±90 deg to shore normal for a given Phase III station were retained. The analysis became slightly more complex when wave sheltering was introduced. The swell was assumed to be a unidirectional, monochromatic wave. If the deepwater swell mean direction of wave propagation was ±90 deg to shore normal, then the data were analyzed.

29. The second step in the Phase III analysis assumed that the two wave

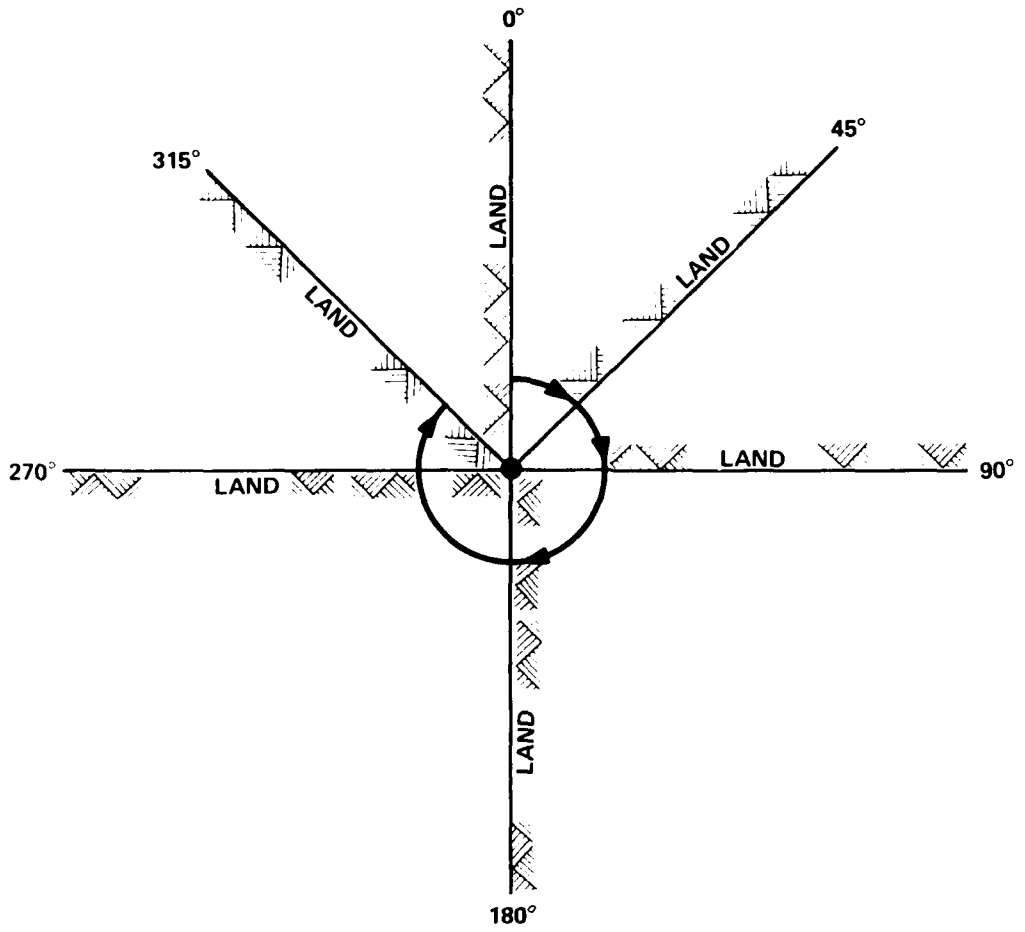

Figure 21. Coordinate system for Atlantic Phase III shoreline orientation

populations were independent; thus, the analysis of the sea and swell transformations into 10 m could be carried out separately. The transformation mechanisms common to both populations were refraction, shoaling, wave breaking, and wave sheltering (when applicable). One additional mechanism involved in the sea wave transformation was the influence due to nonlinear transfers of spectral energy, known as wave-wave interactions. Any number of transformation mechanisms can be considered within the framework of this approach. This means that it is easy to add or delete mechanisms from the computer analog. As shallow-water wave transformation mechanisms become more clearly understood, the Phase III data will be updated. At the present time, the processes included in the Phase III methodology provide an accurate basis for the generation of a shallow-water wave climate.

30. The 20-year parameter data set for each of the 166 Phase III

locations has been transferred to NCDC and incorporated into their master library. These data sets may be obtained from Customer Service at NCDC (reference Tape Deck 9787). Corps of Engineers personnel can access these wave data for site-specific calculations by way of SEAS (Ragsdale 1983).

PART VIII: WATER LEVEL DATA

31. Using data from 20 National Ocean Service (NOS) tidal reference stations (Figure 22 and Table 6), the following water level statistics have been calculated for the Atlantic coast: (a) monthly and yearly mean sea levels, (b) return periods of extreme storm surges, (c) durations of storm surges and total water levels, and (d) probability density and cumulative distribution values for tides, storm surges, and total water levels. These statistics have been published in WIS Report 7 along with descriptions of how the information was generated and how the data may be extrapolated into data-sparse areas (Ebersole 1982).

32. At present (1984), the water level data for the Atlantic coast are archived at WES. However, this data set is scheduled for transfer to NCDC and incorporation into Tape Deck 9787. Also, WIS plans to integrate these data into the SEAS (Ragsdale 1983).

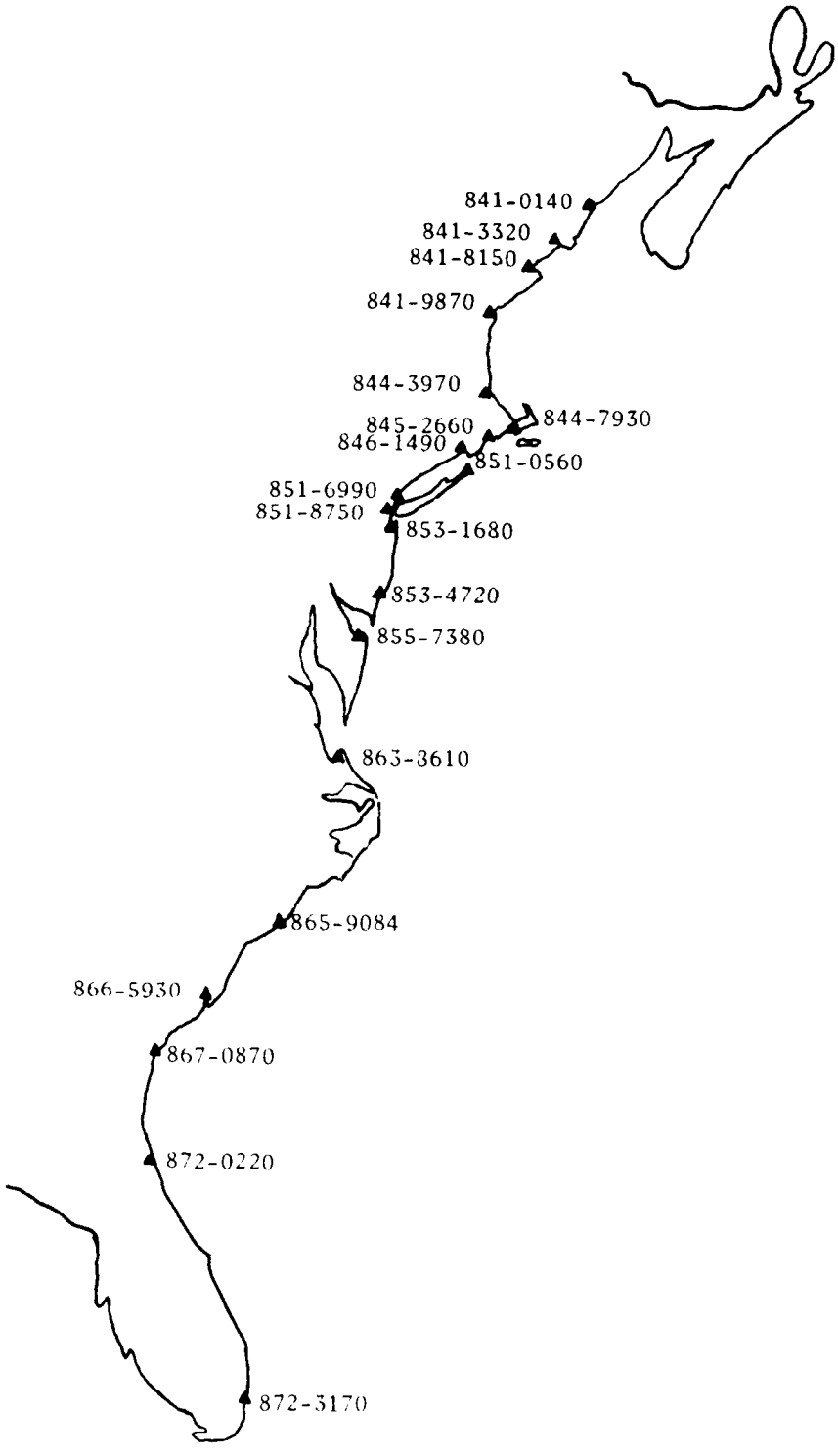

Figure 22. Geographical locations of Atlantic coast tidal reference stations investigated in the WIS

Table 5 (Continued)

Station Number	Latitude	Longitude	Shoreline Angle	Description
43	41.07°	71.86°	67°	Montauk Point (Long Island), New York
44	40.99°	72.05°	68°	Hither Hills Saint Park Beach (Long Island), New York
45	40.92°	72.25°	65°	~1 nautical mile south of Georgica Pond (Long Island), New York
46	40.85°	72.45°	69°	~1.5 nautical miles north of Shinnecock Inlet, New York
47	40.79°	72.65°	68°	Westhampton Beach (Long Island), New York
48	40.74°	72.86°	67°	Great South Beach (Fire Island), New York
49	40.67°	73.05°	77°	Great South Beach (Fire Island), New York
50	40.62°	73.42°	74°	~2 nautical miles north of Democrat Point (Fire Island), New York
51	40.60°	73.48°	90°	Tobay Beach, New York
52	40.58°	73.70°	90°	Long Beach, New York
53	40.56°	73.91°	19°	~1.5 nautical miles north of Rockaway Point, New York
54	40.40°	73.94°	4°	Sandy Hook, New Jersey
55	40.23°	74.00°	13°	~2.5 nautical miles north of Shark River Inlet, New Jersey
56	40.07°	74.04°	9°	Bay Head, New Jersey
57	39.90°	74.08°	12°	Seaside Park, New Jersey
58	39.74°	74.12°	12°	~1 nautical mile south of Barnegat Inlet, New Jersey
59	39.59°	74.23°	33°	Spray Beach, New Jersey
60	39.46°	74.32°	34°	Between Brigartine and Little Egg Inlets, New Jersey
61	39.34°	74.47°	54°	Atlantic City, New Jersey
62	39.23°	74.63°	31°	Peck Beach, New Jersey
63	39.09°	74.73°	35°	Seven Mile Beach, New Jersey
64	38.95°	74.85°	51°	Two Mile Beach, New Jersey
65	38.78°	75.09°	353°	Cape Henlopen, Delaware
66	38.62°	75.06°	357°	Near Indian River Inlet, Delaware
67	38.46°	75.05°	12°	Near Fenwich Island Light, Delaware
68	38.30°	75.11°	27°	~1.5 nautical miles south of Ocean City, Maryland
69	38.14°	75.17°	26°	Assateague Island (North), Maryland
70	37.99°	75.27°	35°	Assateague Island (South), Virginia
71	37.86°	75.36°	53°	Assateague Island (South), Virginia
72	37.77°	75.54°	22°	~1/2 nautical mile south of Gargathy Inlet, Virginia
73	37.61°	75.61°	20°	Cedar Island, Virginia
74	37.45°	75.66°	28°	Hog Island, Virginia
75	37.31°	75.77°	30°	Cobb Island, Virginia
76	37.15°	75.86°	28°	Smith Island, Virginia
77	36.92°	75.99°	342°	Cape Henry, Virginia
78	36.73°	75.94°	339°	Sand Bridge, Virginia
79	36.57°	75.87°	348°	False Cape, Virginia
80	36.41°	75.83°	346°	Corolla, North Carolina
81	36.25°	75.71°	340°	~2.5 nautical miles south of Piper Hill, North Carolina
82	36.09°	75.70°	332°	Kitty Hawk Beach, North Carolina
83	35.94°	75.61°	335°	Nags Head, North Carolina
84	35.81°	75.55°	339°	~1.5 nautical miles north of Oregon Inlet, Bodie Island, North Carolina

(Continued)

Table 5

Shoreline Points for Atlantic Coast Phase III Wave Information Study

Station Number	Latitude	Longitude	Shoreline Angle	Description
1	44.82°	66.95°	54°	West Quoddy Head, Maine
2	44.70°	67.12°	59°	~2 nautical miles south of Moose Cove, Maine
3	44.60°	67.30°	62°	Cross Island, Maine
4	44.49°	67.62°	68°	Black Head Island, Maine
5	44.42°	67.86°	56°	Bois Bubert Island, Maine
6	44.33°	68.03°	55°	Schoodic Island, Maine
7	44.24°	68.20°	37°	Baker Island, Maine
8	44.10°	68.33°	63°	Long Island Head, Maine
9	44.04°	68.55°	50°	Great Spoon Island, Maine
10	43.86°	68.81°	78°	Wooden Ball Island, Maine
11	43.77°	69.32°	73°	Mohegan Island, Maine
12	43.68°	69.58°	90°	Pumpkin Island, Maine
13	43.70°	69.84°	90°	Cape Small (Small Point), Maine
14	43.68°	70.09°	30°	Jewell Island, Maine
15	43.54°	70.23°	53°	Richmond Island (Adam Head), Maine
16	43.41°	70.38°	54°	Hoyt Neck, Maine
17	43.41°	70.56°	14°	Wells Beach, Maine
18	43.16°	70.59°	33°	Cape Neddick, Maine
19	43.04°	70.71°	28°	Odiornes Point, New Hampshire
20	42.89°	70.70°	359°	Hampton Harbor Entrance, New Hampshire
21	42.73°	70.78°	295°	Plum Island, Massachussetts
22	42.64°	70.57°	49°	Thacker Island, Massachusetts
23	42.56°	70.77°	35°	Gales Point (Manchester), Massachusetts
24	42.42°	70.90°	335°	East Point (Nahant), Massachusetts
25	42.27°	70.82°	321°	Near Nantasket Beach, Massachusetts
26	42.13	70.68°	335°	Humarock Beach, Massachusetts
27	42.00°	70.58°	244°	Rocky Point (Plymouth Bay), Massachusetts
28	42.08°	70.17°	308°	Near Race Point (Cape Cod), Massachusetts
29	41.97°	70.00°	343°	Highlands (Cape Cod), Massachusetts
30	41.82°	69.94°	1°	1/2 nautical mile north of Nauset Harbor Entrance, Massachusetts
31	41.65°	69.95°	17°	1/2 nautical mile north of Chatham Harbor Entrance, Massachusetts
32	41.37°	70.02°	326°	Great Point (Nantucket Island), Massachusetts
33	41.28°	69.97°	98°	Sankaty Head (Nantucket Island), Massachusetts
34	41.26°	70.16°	108°	Madaket (Nantucket Island), Massachusetts
35	41.35°	70.46°	83°	Wasque Point (Chappaquiddick Island), Massachusetts
36	41.35°	70.66°	48°	Near Tisbury Great Pond (Marthas Vineyard), Massachusetts
37	41.25°	70.82°	143°	Nomans Land Island, Massachusetts
38	41.41°	70.95°	99°	Cuttyhunk Island, Massachusetts
39	41.46°	71.17°	88°	Warren Point, Rhode Island
40	41.45°	71.39°	43°	Beavertail Point (Conanicut Island), Rhode Island
41	41.36°	71.48°	11°	Point Judith, Rhode Island
42	41.15°	71.55°	70°	Southeast Point (Block Island), New York

(Continued)

Table 4

Atlantic WIS Phase II Station Locations

STATION	SOG I-J	N LAT(DEG)	W LON(DEG)	STATION	SOG I-J	N LAT(DEG)	W LON(DEG)	STATION	SOG I-J	N LAT(DEG)	W LON(DEG)
1	4,30	44.24	67.71	26	11,23	40.39	71.87	51	25,8	32.42	79.68
2	4,31	44.28	67.02	27*	12,20	39.68	73.72	52*	25,9	32.51	79.10
3	4,32	44.32	66.32	28*	13,19	39.12	74.26	53	25,10	32.60	78.51
4	5,28	43.64	69.02	29	13,20	39.20	73.62	54*	26,7	31.86	80.15
5*	5,29	43.69	68.33	30*	14,18	38.55	74.79	55*	27,6	31.29	80.62
6	5,30	43.74	67.65	31	14,19	38.63	74.16	56	27,7	31.39	80.01
7	5,31	43 79	66.96	32*	15,18	38.07	74.69	57*	28,5	30.73	81.08
8	6,26	43.03	70.31	33*	16,17	37.51	75.21	58*	28,6	30.82	80.51
9*	6,27	43.09	69 63	34	16,18	37.59	74.59	59	29,5	30.26	80.98
10	6,28	43.15	68.95	35*	17,17	37.03	75.11	60*	30,5	29.79	80.88
11	6,31	43.29	66.90	36	18,17	36.54	75.02	61	30,6	29.89	80.31
12	6,32	43.33	66.21	37*	19,17	36.06	74.92	62*	31,6	29.42	80.21
13*	7,26	42 54	70.23	38*	20,17	35.58	74.83	63	32,6	28.95	80.11
14	7,27	42.60	69.55	39*	21,16	35.02	75.34	64*	33,6	28.48	80.02
15	7,32	42.83	66.16	40	21,17	35.09	74.74	65	34,6	28.01	79.93
16*	8,27	42 11	69.48	41	22,12	34.12	77.64	66*	35,6	27.54	79.84
17*	9,27	41.61	69.40	42*	22,13	34.29	77.04	67	36,6	27 07	79.75
18	10,23	40.88	71.96	43	22,14	34.38	76.45	68	36,7	27.15	79.20
19*	10,24	40.94	71.30	44*	22,15	34.46	75.85	69	36,8	27.23	78.64
20	10,25	41.01	70.65	45	22,16	34.54	75.25	70*	37,6	26.60	79.67
21*	10,26	41.06	69 99	46	23,10	33.55	78.72	71*	38,6	26.13	79.58
22	10,27	41.12	69 33	47*	23,11	33.64	78.13	72	38,7	26.20	79.03
23*	11,20	40.17	73.82	48	23,12	33.73	77.54	73	39,6	25.66	79 50
24	11,21	40.24	73.17	49*	24,10	33.08	78.62				
25*	11,22	40.32	72.52	50	25,7	32.33	80.26				

* Wave data were published for 33 of the 73 Atlantic Phase II stations.

Table 3

Atlantic WIS Phase I Station Locations

No.	I, J	Latitude	Longitude
1	15, 9	41.87	65.40
2	15, 8	41.72	68.07
3	16, 7	39.53	70.42
4	17, 6	37.32	72.63
5	18, 6	35.37	72.31
6	19, 5	33.16	74.40
7	19, 4	32.86	76.76
8	20, 3	30.62	78.70
9	21, 3	28.73	78.34
10	22, 3	26.83	78.01
11	26, 8	19.89	66.40
12	26, 9	19.95	64.27
13	26, 10	19.99	62.15

Table 2 (Concluded)

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
37, 1	26.18	82.42	38, 1	25.71	82.32	39, 1	25.25	82.23
37, 2	26.27	81.87	38, 2	25.80	81.78	39, 2	25.34	81.69
37, 3	26.35	81.32	38, 3	25.89	81.23	39, 3	25.42	81.14
37, 4	26.44	80.77	38, 4	25.97	80.68	39, 4	25.50	80.60
37, 5	26.52	80.22	38, 5	26.05	80.13	39, 5	25.58	80.05
37, 6	26.60	79.67	38, 6	26.13	79.58	39, 6	25.66	79.50
37, 7	26.68	79.11	38, 7	26.20	79.03	39, 7	25.73	78.95
37, 8	26.75	78.56	38, 8	26.28	78.48	39, 8	25.80	78.40
37, 9	26.83	78.01	38, 9	26.35	77.93	39, 9	25.87	77.85
37, 10	26.90	77.45	38, 10	26.42	77.38	39, 10	25.94	77.30
37, 11	26.97	76.90	38, 11	26.49	76.82	39, 11	26.01	76.75
37, 12	27.03	76.34	38, 12	26.55	76.27	39, 12	26.07	76.20
37, 13	27.10	75.78	38, 13	26.62	75.72	39, 13	26.14	75.65
37, 14	27.16	75.23	38, 14	26.68	75.16	39, 14	26.20	75.10
37, 15	27.22	74.67	38, 15	26.74	74.61	39, 15	26.25	74.54
37, 16	27.28	74.11	38, 16	26.79	74.05	39, 16	26.31	73.99
37, 17	27.34	73.55	38, 17	26.85	73.49	39, 17	26.36	73.43
37, 18	27.39	72.99	38, 18	26.90	72.94	39, 18	26.42	72.88
37, 19	27.44	72.43	38, 19	26.95	72.38	39, 19	26.46	72.32
37, 20	27.49	71.87	38, 20	27.00	71.82	39, 20	26.51	71.77
37, 21	27.54	71.31	38, 21	27.05	71.26	39, 21	26.56	71.21
37, 22	27.58	70.75	38, 22	27.09	70.70	39, 22	26.60	70.65
37, 23	27.63	70.19	38, 23	27.13	70.14	39, 23	26.64	70.10
37, 24	27.67	69.62	38, 24	27.17	69.58	39, 24	26.68	69.54
37, 25	27.70	69.06	38, 25	27.21	69.02	39, 25	26.72	68.98
37, 26	27.74	68.50	38, 26	27.25	68.46	39, 26	26.75	68.42
37, 27	27.77	67.93	38, 27	27.28	67.90	39, 27	26.78	67.86
37, 28	27.80	67.37	38, 28	27.31	67.34	39, 28	26.81	67.30
37, 29	27.83	66.81	38, 29	27.34	66.78	39, 29	26.84	66.75
37, 30	27.86	66.24	38, 30	27.36	66.21	39, 30	26.87	66.19
37, 31	27.88	65.68	38, 31	27.39	65.65	39, 31	26.89	65.63
37, 32	27.91	65.11	38, 32	27.41	65.09	39, 32	26.91	65.07
37, 33	27.93	64.55	38, 33	27.43	64.53	39, 33	26.93	64.51

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
40, 1	24.79	82.15	41, 1	24.33	82.06
40, 2	24.87	81.60	41, 2	24.41	81.52
40, 3	24.95	81.06	41, 3	24.49	80.98
40, 4	25.03	80.51	41, 4	24.56	80.43
40, 5	25.11	79.97	41, 5	24.64	79.89
40, 6	25.18	79.42	41, 6	24.71	79.35
40, 7	25.26	78.88	41, 7	24.78	78.80
40, 8	25.33	78.33	41, 8	24.85	78.26
40, 9	25.40	77.78	41, 9	24.92	77.71
40, 10	25.47	77.23	41, 10	24.99	77.16
40, 11	25.53	76.68	41, 11	25.05	76.62
40, 12	25.59	76.13	41, 12	25.11	76.07
40, 13	25.65	75.58	41, 13	25.17	75.52
40, 14	25.71	75.03	41, 14	25.23	74.97
40, 15	25.77	74.48	41, 15	25.29	74.42
40, 16	25.82	73.93	41, 16	25.34	73.87
40, 17	25.88	73.38	41, 17	25.39	73.32
40, 18	25.93	72.82	41, 18	25.44	72.77
40, 19	25.98	72.27	41, 19	25.49	72.22
40, 20	26.02	71.72	41, 20	25.53	71.67
40, 21	26.07	71.16	41, 21	25.58	71.12
40, 22	26.11	70.61	41, 22	25.62	70.56
40, 23	26.15	70.05	41, 23	25.66	70.01
40, 24	26.19	69.50	41, 24	25.69	69.46
40, 25	26.22	68.94	41, 25	25.73	68.90
40, 26	26.26	68.39	41, 26	25.76	68.35
40, 27	26.29	67.83	41, 27	25.79	67.80
40, 28	26.32	67.27	41, 28	25.82	67.24
40, 29	26.34	66.72	41, 29	25.85	66.69
40, 30	26.37	66.16	41, 30	25.87	66.13
40, 31	26.39	65.60	41, 31	25.89	65.58
40, 32	26.41	65.04	41, 32	25.91	65.02
40, 33	26.43	64.49	41, 33	25.93	64.47

Table 2 (Continued)

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
28, 1	30.32	83.36	29, 1	29.86	83.24	30, 1	29.40	83.13
28, 2	30.43	82.79	29, 2	29.97	82.68	30, 2	29.50	82.57
28, 3	30.53	82.22	29, 3	30.07	82.11	30, 3	29.60	82.01
28, 4	30.63	81.66	29, 4	30.17	81.55	30, 4	29.70	81.44
28, 5	30.73	81.08	29, 5	30.26	80.98	30, 5	29.79	80.88
28, 6	30.82	80.51	29, 6	30.36	80.41	30, 6	29.89	80.31
23, 7	30.92	79.94	29, 7	30.45	79.84	30, 7	29.98	79.74
28, 8	31.01	79.37	29, 8	30.54	79.27	30, 8	30.06	79.17
28, 9	31.09	78.79	29, 9	30.62	78.70	30, 9	30.15	78.60
28, 10	31.18	78.22	29, 10	30.71	78.12	30, 10	30.23	78.03
28, 11	31.26	77.64	29, 11	30.79	77.55	30, 11	30.31	77.46
28, 12	31.34	77.06	29, 12	30.86	76.98	30, 12	30.39	76.89
28, 13	31.42	76.49	29, 13	30.94	76.40	30, 13	30.46	76.32
28, 14	31.50	75.91	29, 14	31.01	75.82	30, 14	30.53	75.74
28, 15	31.57	75.33	29, 15	31.09	75.25	30, 15	30.60	75.17
28, 16	31.64	74.74	29, 16	31.15	74.67	30, 16	30.67	74.59
28, 17	31.70	74.16	29, 17	31.22	74.09	30, 17	30.73	74.02
28, 18	31.77	73.58	29, 18	31.28	73.51	30, 18	30.80	73.44
28, 19	31.83	73.00	29, 19	31.34	72.93	30, 19	30.86	72.86
28, 20	31.89	72.41	29, 20	31.40	72.35	30, 20	30.91	72.28
28, 21	31.95	71.83	29, 21	31.46	71.76	30, 21	30.97	71.70
28, 22	32.00	71.24	29, 22	31.51	71.18	30, 22	31.02	71.12
28, 23	32.05	70.65	29, 23	31.56	70.60	30, 23	31.07	70.54
28, 24	32.10	70.07	29, 24	31.61	70.01	30, 24	31.11	69.96
28, 25	32.14	69.48	29, 25	31.65	69.43	30, 25	31.16	69.38
28, 26	32.19	68.89	29, 26	31.69	68.84	30, 26	31.20	68.80
28, 27	32.23	68.30	29, 27	31.73	68.26	30, 27	31.24	68.21
28, 28	32.26	67.71	29, 28	31.77	67.67	30, 28	31.27	67.63
28, 29	32.30	67.12	29, 29	31.80	67.08	30, 29	31.31	67.05
28, 30	32.33	66.53	29, 30	31.83	66.50	30, 30	31.34	66.46
28, 31	32.36	65.94	29, 31	31.86	65.91	30, 31	31.37	65.88
28, 32	32.39	65.35	29, 32	31.89	65.32	30, 32	31.39	65.29
28, 33	32.41	64.76	29, 33	31.91	64.73	30, 33	31.41	64.71

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
31, 1	28.94	83.02	32, 1	28.48	82.92	33, 1	28.02	82.81
31, 2	29.04	82.46	32, 2	28.58	82.36	33, 2	28.12	82.25
31, 3	29.14	81.90	32, 3	28.68	81.80	33, 3	28.21	81.70
31, 4	29.24	81.34	32, 4	28.77	81.24	33, 4	28.30	81.14
31, 5	29.33	80.78	32, 5	28.86	80.68	33, 5	28.39	80.58
31, 6	29.42	80.21	32, 6	28.95	80.11	33, 6	28.48	80.02
31, 7	29.51	79.65	32, 7	29.03	79.55	33, 7	28.56	79.46
31, 8	29.59	79.08	32, 8	29.12	78.99	33, 8	28.65	78.90
31, 9	29.67	78.51	32, 9	29.20	78.42	33, 9	28.73	78.34
31, 10	29.75	77.94	32, 10	29.28	77.86	33, 10	28.80	77.77
31, 11	29.83	77.38	32, 11	29.36	77.29	33, 11	28.88	77.21
31, 12	29.91	76.81	32, 12	29.43	76.72	33, 12	28.95	76.64
31, 13	29.98	76.23	32, 13	29.50	76.16	33, 13	29.02	76.08
31, 14	30.05	75.66	32, 14	29.57	75.59	33, 14	29.09	75.51
31, 15	30.12	75.09	32, 15	29.64	75.02	33, 15	29.15	74.94
31, 16	30.19	74.52	32, 16	29.70	74.45	33, 16	29.22	74.38
31, 17	30.25	73.94	32, 17	29.76	73.87	33, 17	29.28	73.81
31, 18	30.31	73.37	32, 18	29.82	73.30	33, 18	29.34	73.24
31, 19	30.37	72.79	32, 19	29.88	72.73	33, 19	29.39	72.67
31, 20	30.42	72.22	32, 20	29.94	72.16	33, 20	29.45	72.10
31, 21	30.48	71.64	32, 21	29.99	71.58	33, 21	29.50	71.53
31, 22	30.53	71.06	32, 22	30.04	71.01	33, 22	29.55	70.95
31, 23	30.58	70.49	32, 23	30.08	70.43	33, 23	29.59	70.38
31, 24	30.62	69.91	32, 24	30.13	69.86	33, 24	29.64	69.81
31, 25	30.66	69.33	32, 25	30.17	69.28	33, 25	29.68	69.24
31, 26	30.71	68.75	32, 26	30.21	68.71	33, 26	29.72	68.66
31, 27	30.74	68.17	32, 27	30 25	68.13	33, 27	29.75	68.09
31, 28	30.78	67.59	32, 28	30.28	67.55	33, 28	29.79	67.51
31, 29	30.81	67.01	32, 29	30.32	66.97	33, 29	29.82	66.94
31, 30	30.84	66.43	32, 30	30.34	66.40	33, 30	29.85	66.36
31, 31	30.87	65.85	32, 31	30.37	65.82	33, 31	29.87	65.79
31, 32	30.89	65.26	32, 32	30.40	65.24	33, 32	29.90	65.21
31, 33	30.92	64.68	32, 33	30.42	64.66	33, 33	29.92	64.64

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
34, 1	27.56	82.71	35, 1	27.10	82.61	36, 1	26.64	82.51
34, 2	27.66	82.15	35, 2	27.19	82.06	36, 2	26.73	81.96
34, 3	27.75	81.60	35, 3	27.28	81.50	36, 3	26.82	81.41
34, 4	27.84	81.04	35, 4	27.37	80.95	36, 4	26.90	80.86
34, 5	27.92	80.49	35, 5	27.46	80.40	36, 5	26.99	80.31
34, 6	28.01	79.93	35, 6	27.54	79.84	36, 6	27.07	79.75
34, 7	28.09	79.37	35, 7	27.62	79.28	36, 7	27.15	79.20
34, 8	28.17	78.81	35, 8	27.70	78.73	36, 8	27.23	78.64
34, 9	28.25	78.25	35, 9	27.78	78.17	36, 9	27.30	78.09
34, 10	28.33	77.69	35, 10	27.85	77.61	36, 10	27.37	77.53
34, 11	28.40	77.13	35, 11	27.92	77.05	36, 11	27.44	76.97
34, 12	28.47	76.57	35, 12	27.99	76.49	36, 12	27.51	76.41
34, 13	28.54	76.00	35, 13	28.06	75.93	36, 13	27.58	75.86
34, 14	28.61	75.44	35, 14	28.13	75.37	36, 14	27.64	75.30
34, 15	28.67	74.87	35, 15	28.19	74.80	36, 15	27.71	74.74
34, 16	28.73	74.31	35, 16	28.25	74.24	36, 16	27.76	74.17
34, 17	28.79	73.74	35, 17	28.31	73.68	36, 17	27.82	73.61
34, 18	28.85	73.17	35, 18	28.36	73.11	36, 18	27.88	73.05
34, 19	28.91	72.61	35, 19	28.42	72.55	36, 19	27.93	72.49
34, 20	28.96	72.04	35, 20	28.47	71.98	36, 20	27.98	71.93
34, 21	29.01	71.47	35, 21	28.52	71.42	36, 21	28.03	71.36
34, 22	29.06	70.90	35, 22	28.57	70.85	36, 22	28.07	70.80
34, 23	29.10	70.33	35, 23	28.61	70.28	36, 23	28.12	70.23
34, 24	29.14	69.76	35, 24	28.65	69.71	36, 24	28.16	69.67
34, 25	29.18	69.19	35, 25	28.69	69.15	36, 25	28.20	69.10
34, 26	29.22	68.62	35, 26	28.73	68.58	36, 26	28.23	68.54
34, 27	29.26	68.05	35, 27	28.76	68.01	36, 27	28.27	67.97
34, 28	29.29	67.48	35, 28	28.80	67.44	36, 28	28.30	67.40
34, 29	29.32	66.90	35, 29	28.83	66.87	36, 29	28.33	66.84
34, 30	29.35	66.33	35, 30	28.85	66.30	36, 30	28.36	66.27
34, 31	29.38	65.76	35, 31	28.88	65.73	36, 31	28.38	65.70
34, 32	29.40	65.19	35, 32	28.90	65.16	36, 32	28.40	65.14
34, 33	29.42	64.61	35, 33	28.92	64.59	36, 33	28.42	64.57

(Continued)

Table 2 (Continued)

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
19, 1	34.43	84.52	20, 1	33.98	84.38	21, 1	33.52	84.24
19, 2	34.56	83.93	20, 2	34.10	83.79	21, 2	33.64	83.66
19, 3	34.68	83.34	20, 3	34.22	83.20	21, 3	33.76	83.07
19, 4	34.80	82.75	20, 4	34.34	82.61	21, 4	33.87	82.48
19, 5	34.91	82.15	20, 5	34.45	82.02	21, 5	33.98	81.90
19, 6	35.02	81.56	20, 6	34.56	81.43	21, 6	34.09	81.31
19, 7	35.13	80.96	20, 7	34.67	80.84	21, 7	34.20	80.72
19, 8	35.24	80.37	20, 8	34.77	80.24	21, 8	34.30	80.13
19, 9	35.34	79.77	20, 9	34.87	79.65	21, 9	34.40	79.53
19, 10	35.44	79.17	20, 10	34.97	79.05	21, 10	34.50	78.94
19, 11	35.54	78.56	20, 11	35.07	78.45	21, 11	34.59	78.34
19, 12	35.63	77.96	20, 12	35.16	77.85	21, 12	34.68	77.74
19, 13	35.73	77.36	20, 13	35.25	77.25	21, 13	34.77	77.15
19, 14	35.81	76.75	20, 14	35.33	76.65	21, 14	34.86	76.55
19, 15	35.90	76.14	20, 15	35.42	76.04	21, 15	34.94	75.94
19, 16	35.98	75.53	20, 16	35.50	75.44	21, 16	35.02	75.34
19, 17	36.06	74.92	20, 17	35.58	74.83	21, 17	35.09	74.74
19, 18	36.14	74.31	20, 18	35.65	74.22	21, 18	35.17	74.13
19, 19	36.21	73.70	20, 19	35.72	73.61	21, 19	35.24	73.53
19, 20	36.28	73.08	20, 20	35.79	73.00	21, 20	35.30	72.92
19, 21	36.34	72.47	20, 21	35.86	72.39	21, 21	35.37	72.31
19, 22	36.41	71.85	20, 22	35.92	71.78	21, 22	35.43	71.71
19, 23	36.47	71.24	20, 23	35.98	71.16	21, 23	35.49	71.10
19, 24	36.53	70.62	20, 24	36.03	70.55	21, 24	35.54	70.49
19, 25	36.58	70.00	20, 25	36.09	69.94	21, 25	35.59	69.87
19, 26	36.63	69.38	20, 26	36.14	69.32	21, 26	35.64	69.26
19, 27	36.68	68.76	20, 27	36.18	68.70	21, 27	35.69	68.65
19, 28	36.72	68.14	20, 28	36.23	68.09	21, 28	35.73	68.04
19, 29	36.76	67.52	20, 29	36.27	67.47	21, 29	35.77	67.42
19, 30	36.80	66.89	20, 30	36.30	66.85	21, 30	35.81	66.81
19, 31	36.83	66.27	20, 31	36.34	66.23	21, 31	35.84	66.19
19, 32	36.87	65.65	20, 32	36.37	65.61	21, 32	35.87	65.58
19, 33	36.89	65.02	20, 33	36.40	64.99	21, 33	35.90	64.96

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
22, 1	33.07	84.10	23, 1	32.61	83.97	24, 1	32.15	83.84
22, 2	33.19	83.52	23, 2	32.73	83.39	24, 2	32.27	83.27
22, 3	33.30	82.94	23, 3	32.84	82.81	24, 3	32.38	82.69
22, 4	33.41	82.36	23, 4	32.95	82.23	24, 4	32.49	82.11
22, 5	33.52	81.77	23, 5	33.06	81.65	24, 5	32.59	81.53
22, 6	33.63	81.19	23, 6	33.16	81.07	24, 6	32.69	80.95
22, 7	33.73	80.60	23, 7	33.26	80.48	24, 7	32.79	80.37
22, 8	33.83	80.01	23, 8	33.36	79.90	24, 8	32.89	79.79
22, 9	33.93	79.42	23, 9	33.46	79.31	24, 9	32.99	79.20
22, 10	34.02	78.83	23, 10	33.55	78.72	24, 10	33.08	78.62
22, 11	34.12	78.23	23, 11	33.64	78.13	24, 11	33.17	78.03
22, 12	34.21	77.64	23, 12	33.73	77.54	24, 12	33.25	77.44
22, 13	34.29	77.04	23, 13	33.81	76.95	24, 13	33.34	76.85
22, 14	34.38	76.45	23, 14	33.90	76.35	24, 14	33.42	76.26
22, 15	34.46	75.85	23, 15	33.98	75.76	24, 15	33.49	75.67
22, 16	34.53	75.25	23, 16	34.05	75.16	24, 16	33.57	75.07
22, 17	34.61	74.65	23, 17	34.13	74.56	24, 17	33.64	74.48
22, 18	34.68	74.05	23, 18	34.20	73.97	24, 18	33.71	73.89
22, 19	34.75	73.45	23, 19	34.26	73.37	24, 19	33.78	73.29
22, 20	34.82	72.84	23, 20	34.33	72.77	24, 20	33.84	72.69
22, 21	34.88	72.24	23, 21	34.39	72.17	24, 21	33.90	72.09
22, 22	34.94	71.63	23, 22	34.45	71.56	24, 22	33.96	71.50
22, 23	35.00	71.03	23, 23	34.51	70.96	24, 23	34.02	70.90
22, 24	35.05	70.42	23, 24	34.56	70.36	24, 24	34.07	70.30
22, 25	35.10	69.81	23, 25	34.61	69.75	24, 25	34.12	69.70
22, 26	35.15	69.20	23, 26	34.66	69.15	24, 26	34.16	69.09
22, 27	35.19	68.60	23, 27	34.70	68.54	24, 27	34.21	68.49
22, 28	35.24	67.99	23, 28	34.74	67.94	24, 28	34.25	67.89
22, 29	35.28	67.38	23, 29	34.78	67.33	24, 29	34.28	67.29
22, 30	35.31	66.76	23, 30	34.81	66.72	24, 30	34.32	66.68
22, 31	35.34	66.15	23, 31	34.85	66.12	24, 31	34.35	66.08
22, 32	35.37	65.54	23, 32	34.88	65.51	24, 32	34.38	65.47
22, 33	35.40	64.93	23, 33	34.90	64.90	24, 33	34.40	64.87

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
25, 1	31.70	83.72	26, 1	31.24	83.60	27, 1	30.78	83.48
25, 2	31.81	83.14	26, 2	31.35	83.02	27, 2	30.89	82.91
25, 3	31.92	82.57	26, 3	31.45	82.45	27, 3	30.99	82.34
25, 4	32.02	81.99	26, 4	31.56	81.88	27, 4	31.09	81.77
25, 5	32.13	81.42	26, 5	31.66	81.30	27, 5	31.19	81.19
25, 6	32.23	80.84	26, 6	31.76	80.73	27, 6	31.29	80.62
25, 7	32.33	80.26	26, 7	31.86	80.15	27, 7	31.39	80.04
25, 8	32.42	79.68	26, 8	31.95	79.57	27, 8	31.48	79.47
25, 9	32.51	79.10	26, 9	32.04	78.99	27, 9	31.57	78.89
25, 10	32.60	78.51	26, 10	32.13	78.41	27, 10	31.65	78.31
25, 11	32.69	77.93	26, 11	32.22	77.83	27, 11	31.74	77.73
25, 12	32.78	77.34	26, 12	32.30	77.25	27, 12	31.82	77.15
25, 13	32.86	76.76	26, 13	32.38	76.66	27, 13	31.90	76.57
25, 14	32.94	76.17	26, 14	32.46	76.08	27, 14	31.98	75.99
25, 15	33.01	75.58	26, 15	32.53	75.49	27, 15	32.05	75.41
25, 16	33.09	74.99	26, 16	32.60	74.91	27, 16	32.12	74.82
25, 17	33.16	74.40	26, 17	32.67	74.32	27, 17	32.19	74.24
25, 18	33.23	73.81	26, 18	32.74	73.73	27, 18	32.25	73.65
25, 19	33.29	73.21	26, 19	32.80	73.14	27, 19	32.32	73.07
25, 20	33.35	72.62	26, 20	32.87	72.55	27, 20	32.38	72.48
25, 21	33.41	72.03	26, 21	32.92	71.96	27, 21	32.44	71.89
25, 22	33.47	71.43	26, 22	32.98	71.37	27, 22	32.49	71.30
25, 23	33.52	70.83	26, 23	33.03	70.77	27, 23	32.54	70.71
25, 24	33.58	70.24	26, 24	33.08	70.18	27, 24	32.59	70.12
25, 25	33.62	69.64	26, 25	33.13	69.59	27, 25	32.64	69.53
25, 26	33.67	69.04	26, 26	33.18	68.99	27, 26	32.68	68.94
25, 27	33.71	68.44	26, 27	33.22	68.39	27, 27	32.72	68.35
25, 28	33.75	67.84	26, 28	33.26	67.80	27, 28	32.76	67.76
25, 29	33.79	67.24	26, 29	33.29	67.20	27, 29	32.80	67.16
25, 30	33.82	66.64	26, 30	33.32	66.61	27, 30	32.83	66.57
25, 31	33.85	66.04	26, 31	33.36	66.01	27, 31	32.86	65.97
25, 32	33.88	65.44	26, 32	33.38	65.41	27, 32	32.88	65.38
25, 33	33.91	64.84	26, 33	33.41	64.81	27, 33	32.91	64.79

(Continued)

Table 2 (Continued)

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
10, 1	38.51	85.93	11, 1	38.06	85.76	12, 1	37.61	85.59
10, 2	38.65	85.32	11, 2	38.20	85.15	12, 2	37.74	84.99
10, 3	38.79	84.71	11, 3	38.33	84.54	12, 3	37.88	84.38
10, 4	38.93	84.09	11, 4	38.47	83.93	12, 4	38.01	83.77
10, 5	39.06	83.47	11, 5	38.60	83.31	12, 5	38.14	83.15
10, 6	39.19	82.85	11, 6	38.73	82.69	12, 6	38.27	82.54
10, 7	39.32	82.22	11, 7	38.85	82.07	12, 7	38.39	81.92
10, 8	39.44	81.60	11, 8	38.98	81.45	12, 8	38.51	81.30
10, 9	39.56	80.97	11, 9	39.09	80.82	12, 9	38.63	80.68
10, 10	39.68	80.34	11, 10	39.21	80.19	12, 10	38.74	80.05
10, 11	39.79	79.70	11, 11	39.32	79.56	12, 11	38.85	79.43
10, 12	39.90	79.07	11, 12	39.43	78.93	12, 12	38.95	78.80
10, 13	40.01	78.43	11, 13	39.53	78.30	12, 13	39.06	78.17
10, 14	40.11	77.79	11, 14	39.63	77.66	12, 14	39.16	77.54
10, 15	40.21	77.15	11, 15	39.73	77.03	12, 15	39.25	76.91
10, 16	40.31	76.51	11, 16	39.83	76.39	12, 16	39.35	76.27
10, 17	40.40	75.86	11, 17	39.92	75.75	12, 17	39.44	75.64
10, 18	40.49	75.22	11, 18	40.00	75.11	12, 18	39.52	75.00
10, 19	40.57	74.57	11, 19	40.09	74.46	12, 19	39.60	74.36
10, 20	40.65	73.92	11, 20	40.17	73.82	12, 20	39.68	73.72
10, 21	40.73	73.27	11, 21	40.24	73.17	12, 21	39.76	73.07
10, 22	40.81	72.61	11, 22	40.32	72.52	12, 22	39.83	72.43
10, 23	40.88	71.96	11, 23	40.39	71.87	12, 23	39.90	71.79
10, 24	40.94	71.30	11, 24	40.45	71.22	12, 24	39.96	71.14
10, 25	41.01	70.65	11, 25	40.51	70.57	12, 25	40.02	70.49
10, 26	41.06	69.99	11, 26	40.57	69.92	12, 26	40.08	69.84
10, 27	41.12	69.33	11, 27	40.63	69.26	12, 27	40.13	69.19
10, 28	41.17	68.67	11, 28	40.68	68.61	12, 28	40.18	68.54
10, 29	41.22	68.01	11, 29	40.73	67.95	12, 29	40.23	67.89
10, 30	41.26	67.35	11, 30	40.77	67.29	12, 30	40.27	67.24
10, 31	41.30	66.68	11, 31	40.81	66.63	12, 31	40.31	66.58
10, 32	41.34	66.02	11, 32	40.84	65.97	12, 32	40.35	65.93
10, 33	41.37	65.36	11, 33	40.88	65.31	12, 33	40.38	65.28

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
13, 1	37.15	85.43	14, 1	36.70	85.27	15, 1	36.25	85.11
13, 2	37.29	84.83	14, 2	36.84	84.67	15, 2	36.38	84.51
13, 3	37.42	84.22	14, 3	36.97	84.06	15, 3	36.51	83.91
13, 4	37.55	83.61	14, 4	37.10	83.46	15, 4	36.64	83.31
13, 5	37.68	83.00	14, 5	37.22	82.85	15, 5	36.76	82.71
13, 6	37.81	82.39	14, 6	37.34	82.24	15, 6	36.88	82.10
13, 7	37.93	81.77	14, 7	37.46	81.63	15, 7	37.00	81.49
13, 8	38.04	81.16	14, 8	37.58	81.02	15, 8	37.11	80.88
13, 9	38.16	80.54	14, 9	37.69	80.40	15, 9	37.22	80.27
13, 10	38.27	79.92	14, 10	37.80	79.79	15, 10	37.33	79.66
13, 11	38.38	79.30	14, 11	37.90	79.17	15, 11	37.43	79.04
13, 12	38.48	78.67	14, 12	38.01	78.55	15, 12	37.53	78.42
13, 13	38.58	78.05	14, 13	38.11	77.92	15, 13	37.63	77.81
13, 14	38.68	77.42	14, 14	38.20	77.30	15, 14	37.73	77.18
13, 15	38.77	76.79	14, 15	38.30	76.68	15, 15	37.82	76.56
13, 16	38.87	76.16	14, 16	38.39	76.05	15, 16	37.91	75.94
13, 17	38.95	75.53	14, 17	38.47	75.42	15, 17	37.99	75.32
13, 18	39.04	74.89	14, 18	38.55	74.79	15, 18	38.07	74.69
13, 19	39.12	74.26	14, 19	38.63	74.16	15, 19	38.15	74.06
13, 20	39.20	73.62	14, 20	38.71	73.53	15, 20	38.22	73.43
13, 21	39.27	72.98	14, 21	38.78	72.89	15, 21	38.30	72.80
13, 22	39.34	72.34	14, 22	38.85	72.26	15, 22	38.36	72.17
13, 23	39.41	71.70	14, 23	38.92	71.62	15, 23	38.43	71.54
13, 24	39.47	71.06	14, 24	38.98	70.98	15, 24	38.49	70.90
13, 25	39.53	70.42	14, 25	39.04	70.34	15, 25	38.55	70.27
13, 26	39.59	69.77	14, 26	39.09	69.70	15, 26	38.60	69.63
13, 27	39.64	69.13	14, 27	39.15	69.06	15, 27	38.65	69.00
13, 28	39.69	68.48	14, 28	39.19	68.42	15, 28	38.70	68.36
13, 29	39.73	67.83	14, 29	39.24	67.78	15, 29	38.74	67.72
13, 30	39.78	67.18	14, 30	39.28	67.13	15, 30	38.78	67.08
13, 31	39.82	66.54	14, 31	39.32	66.49	15, 31	38.82	66.44
13, 32	39.85	65.89	14, 32	39.35	65.84	15, 32	38.86	65.80
13, 33	39.88	65.24	14, 33	39.38	65.20	15, 33	38.89	65.16

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
16, 1	35.80	84.96	17, 1	35.34	84.81	18, 1	34.89	84.66
16, 2	35.93	84.36	17, 2	35.47	84.21	18, 2	35.01	84.07
16, 3	36.05	83.76	17, 3	35.60	83.62	18, 3	35.14	83.48
16, 4	36.18	83.16	17, 4	35.72	83.02	18, 4	35.26	82.88
16, 5	36.30	82.56	17, 5	35.84	82.42	18, 5	35.37	82.29
16, 6	36.42	81.96	17, 6	35.95	81.82	18, 6	35.49	81.69
16, 7	36.53	81.35	17, 7	36.07	81.22	18, 7	35.60	81.09
16, 8	36.64	80.75	17, 8	36.18	80.62	18, 8	35.71	80.49
16, 9	36.75	80.14	17, 9	36.28	80.01	18, 9	35.81	79.89
16, 10	36.86	79.53	17, 10	36.39	79.41	18, 10	35.91	79.28
16, 11	36.96	78.92	17, 11	36.49	78.80	18, 11	36.01	78.68
16, 12	37.06	78.30	17, 12	36.58	78.19	18, 12	36.11	78.07
16, 13	37.16	77.69	17, 13	36.68	77.57	18, 13	36.20	77.46
16, 14	37.25	77.07	17, 14	36.77	76.96	18, 14	36.29	76.85
16, 15	37.34	76.45	17, 15	36.86	76.35	18, 15	36.38	76.24
16, 16	37.42	75.83	17, 16	36.94	75.73	18, 16	36.46	75.63
16, 17	37.51	75.21	17, 17	37.03	75.11	18, 17	36.54	75.02
16, 18	37.59	74.59	17, 18	37.10	74.50	18, 18	36.62	74.40
16, 19	37.66	73.97	17, 19	37.18	73.88	18, 19	36.69	73.79
16, 20	37.74	73.34	17, 20	37.25	73.25	18, 20	36.76	73.17
16, 21	37.81	72.72	17, 21	37.32	72.63	18, 21	36.83	72.55
16, 22	37.87	72.09	17, 22	37.39	72.01	18, 22	36.90	71.93
16, 23	37.94	71.46	17, 23	37.45	71.38	18, 23	36.96	71.31
16, 24	38.00	70.83	17, 24	37.51	70.76	18, 24	37.02	70.69
16, 25	38.06	70.20	17, 25	37.56	70.13	18, 25	37.07	70.06
16, 26	38.11	69.57	17, 26	37.62	69.50	18, 26	37.12	69.44
16, 27	38.16	68.94	17, 27	37.67	68.88	18, 27	37.17	68.82
16, 28	38.21	68.30	17, 28	37.71	68.25	18, 28	37.22	68.19
16, 29	38.25	67.67	17, 29	37.75	67.62	18, 29	37.26	67.57
16, 30	38.29	67.03	17, 30	37.79	66.99	18, 30	37.30	66.94
16, 31	38.32	66.40	17, 31	37.83	66.36	18, 31	37.33	66.31
16, 32	38.36	65.76	17, 32	37.86	65.72	18, 32	37.36	65.69
16, 33	38.39	65.13	17, 33	37.89	65.09	18, 33	37.39	65.06

(Continued)

Table 2

Atlantic Phase II SOG Latitude - Longitude Coordinates

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
1, 1	42.52	87.67	2, 1	42.08	87.46	3, 1	41.64	87.25
1, 2	42.69	87.03	2, 2	42.24	86.82	3, 2	41.80	86.62
1, 3	42.85	86.38	2, 3	42.40	86.18	3, 3	41.95	85.98
1, 4	43.01	85.74	2, 4	42.56	85.54	3, 4	42.10	85.34
1, 5	43.16	85.08	2, 5	42.71	84.89	3, 5	42.25	84.70
1, 6	43.31	84.43	2, 6	42.86	84.24	3, 6	42.40	84.05
1, 7	43.46	83.77	2, 7	43.00	83.58	3, 7	42.54	83.40
1, 8	43.60	83.11	2, 8	43.14	82.93	3, 8	42.68	82.75
1, 9	43.74	82.45	2, 9	43.28	82.27	3, 9	42.82	82.09
1, 10	43.88	81.78	2, 10	43.41	81.60	3, 10	42.95	81.43
1, 11	44.01	81.11	2, 11	43.54	80.94	3, 11	43.07	80.77
1, 12	44.14	80.44	2, 12	43.67	80.27	3, 12	43.21	80.11
1, 13	44.26	79.76	2, 13	43.79	79.60	3, 13	43.32	79.44
1, 14	44.38	79.08	2, 14	43.91	78.93	3, 14	43.43	78.77
1, 15	44.49	78.40	2, 15	44.02	78.25	3, 15	43.54	78.10
1, 16	44.61	77.72	2, 16	44.13	77.57	3, 16	43.65	77.43
1, 17	44.71	77.03	2, 17	44.23	76.89	3, 17	43.76	76.75
1, 18	44.82	76.34	2, 18	44.34	76.21	3, 18	43.86	76.07
1, 19	44.92	75.65	2, 19	44.43	75.52	3, 19	43.95	75.39
1, 20	45.01	74.96	2, 20	44.53	74.83	3, 20	44.04	74.71
1, 21	45.10	74.26	2, 21	44.62	74.14	3, 21	44.13	74.02
1, 22	45.19	73.57	2, 22	44.70	73.45	3, 22	44.22	73.34
1, 23	45.27	72.87	2, 23	44.78	72.75	3, 23	44.29	72.65
1, 24	45.35	72.16	2, 24	44.86	72.06	3, 24	44.37	71.96
1, 25	45.42	71.46	2, 25	44.93	71.36	3, 25	44.44	71.26
1, 26	45.49	70.75	2, 26	45.00	70.66	3, 26	44.51	70.57
1, 27	45.56	70.05	2, 27	45.06	69.96	3, 27	44.57	69.87
1, 28	45.62	69.34	2, 28	45.12	69.25	3, 28	44.63	69.18
1, 29	45.67	68.63	2, 29	45.18	68.55	3, 29	44.68	68.48
1, 30	45.72	67.91	2, 30	45.23	67.84	3, 30	44.73	67.76
1, 31	45.77	67.20	2, 31	45.28	67.14	3, 31	44.78	67.03
1, 32	45.81	66.49	2, 32	45.32	66.43	3, 32	44.82	66.37
1, 33	45.85	65.77	2, 33	45.35	65.72	3, 33	44.86	65.67

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
4, 1	41.19	87.05	5, 1	40.74	86.85	6, 1	40.30	86.66
4, 2	41.35	86.42	5, 2	40.90	86.23	6, 2	40.45	86.04
4, 3	41.50	85.79	5, 3	41.05	85.60	6, 3	40.60	85.41
4, 4	41.65	85.15	5, 4	41.20	84.96	6, 4	40.75	84.78
4, 5	41.80	84.51	5, 5	41.34	84.33	6, 5	40.89	84.15
4, 6	41.94	83.87	5, 6	41.49	83.69	6, 6	41.03	83.51
4, 7	42.08	83.22	5, 7	41.62	83.04	6, 7	41.16	82.87
4, 8	42.22	82.57	5, 8	41.76	82.40	6, 8	41.30	82.21
4, 9	42.35	81.92	5, 9	41.89	81.75	6, 9	41.42	81.59
4, 10	42.48	81.26	5, 10	42.02	81.10	6, 10	41.55	80.94
4, 11	42.61	80.61	5, 11	42.14	80.45	6, 11	41.67	80.29
4, 12	42.73	79.95	5, 12	42.26	79.79	6, 12	41.79	79.64
4, 13	42.85	79.29	5, 13	42.37	79.14	6, 13	41.90	78.99
4, 14	42.96	78.62	5, 14	42.49	78.47	6, 14	42.01	78.33
4, 15	43.07	77.95	5, 15	42.59	77.81	6, 15	42.12	77.67
4, 16	43.18	77.29	5, 16	42.70	77.15	6, 16	42.22	77.01
4, 17	43.28	76.61	5, 17	42.80	76.48	6, 17	42.32	76.35
4, 18	43.38	75.94	5, 18	42.89	75.81	6, 18	42.41	75.69
4, 19	43.47	75.26	5, 19	42.99	75.14	6, 19	42.50	75.02
4, 20	43.56	74.59	5, 20	43.08	74.47	6, 20	42.59	74.35
4, 21	43.65	73.91	5, 21	43.16	73.79	6, 21	42.68	73.68
4, 22	43.73	73.22	5, 22	43.24	73.12	6, 22	42.75	73.01
4, 23	43.81	72.54	5, 23	43.32	72.44	6, 23	42.83	72.34
4, 24	43.88	71.86	5, 24	43.39	71.76	6, 24	42.90	71.66
4, 25	43.95	71.17	5, 25	43.46	71.08	6, 25	42.97	70.99
4, 26	44.02	70.48	5, 26	43.52	70.39	6, 26	43.03	70.31
4, 27	44.08	69.79	5, 27	43.59	69.71	6, 27	43.09	69.63
4, 28	44.14	69.10	5, 28	43.64	69.02	6, 28	43.15	68.95
4, 29	44.19	68.40	5, 29	43.69	68.33	6, 29	43.20	68.27
4, 30	44.24	67.71	5, 30	43.74	67.65	6, 30	43.25	67.58
4, 31	44.28	67.02	5, 31	43.79	66.96	6, 31	43.29	66.90
4, 32	44.32	66.32	5, 32	43.83	66.27	6, 32	43.33	66.21
4, 33	44.36	65.62	5, 33	43.86	65.57	6, 33	43.36	65.53

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
7, 1	39.85	86.47	8, 1	39.40	86.29	9, 1	38.95	86.11
7, 2	40.00	85.85	8, 2	39.55	85.67	9, 2	39.10	85.49
7, 3	40.15	85.23	8, 3	39.70	85.05	9, 3	39.24	84.88
7, 4	40.29	84.60	8, 4	39.84	84.43	9, 4	39.38	84.26
7, 5	40.43	83.97	8, 5	39.98	83.80	9, 5	39.52	83.63
7, 6	40.57	83.34	8, 6	40.11	83.17	9, 6	39.65	83.01
7, 7	40.70	82.70	8, 7	40.24	82.54	9, 7	39.78	82.38
7, 8	40.83	82.07	8, 8	40.37	81.91	9, 8	39.90	81.75
7, 9	40.96	81.43	8, 9	40.49	81.27	9, 9	40.03	81.12
7, 10	41.08	80.78	8, 10	40.61	80.63	9, 10	40.15	80.48
7, 11	41.20	80.14	8, 11	40.73	79.99	9, 11	40.26	79.85
7, 12	41.32	79.49	8, 12	40.84	79.35	9, 12	40.37	79.21
7, 13	41.43	78.84	8, 13	40.95	78.70	9, 13	40.48	78.56
7, 14	41.54	78.19	8, 14	41.06	78.06	9, 14	40.59	77.92
7, 15	41.64	77.54	8, 15	41.16	77.41	9, 15	40.69	77.28
7, 16	41.74	76.88	8, 16	41.26	76.75	9, 16	40.78	76.63
7, 17	41.84	76.22	8, 17	41.36	76.10	9, 17	40.88	75.98
7, 18	41.93	75.57	8, 18	41.45	75.45	9, 18	40.97	75.33
7, 19	42.02	74.90	8, 19	41.54	74.79	9, 19	41.06	74.68
7, 20	42.11	74.24	8, 20	41.62	74.13	9, 20	41.14	74.02
7, 21	42.19	73.57	8, 21	41.70	73.47	9, 21	41.22	73.37
7, 22	42.27	72.91	8, 22	41.78	72.81	9, 22	41.29	72.71
7, 23	42.34	72.24	8, 23	41.85	72.14	9, 23	41.36	72.05
7, 24	42.41	71.57	8, 24	41.92	71.48	9, 24	41.43	71.39
7, 25	42.48	70.90	8, 25	41.99	70.81	9, 25	41.50	70.73
7, 26	42.54	70.23	8, 26	42.05	70.14	9, 26	41.56	70.07
7, 27	42.60	69.55	8, 27	42.11	69.48	9, 27	41.61	69.40
7, 28	42.65	68.88	8, 28	42.16	68.81	9, 28	41.67	68.74
7, 29	42.70	68.20	8, 29	42.21	68.13	9, 29	41.72	68.07
7, 30	42.75	67.52	8, 30	42.26	67.46	9, 30	41.76	67.40
7, 31	42.79	66.84	8, 31	42.30	66.79	9, 31	41.80	66.74
7, 32	42.83	66.16	8, 32	42.34	66.11	9, 32	41.84	66.07
7, 33	42.87	65.48	8, 33	42.37	65.44	9, 33	41.87	65.40

(Continued)

Table 1 (Concluded)

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
25, 1	20.61	81.45	26, 1	18.75	81.19	27, 1	16.88	80.96	28, 1	15.01	80.75
25, 2	20.87	79.33	26, 2	18.98	79.09	27, 2	17.09	78.88	28, 2	15.20	78.69
25, 3	21.11	77.20	26, 3	19.20	76.98	27, 3	17.28	76.79	28, 3	15.37	76.62
25, 4	21.31	75.07	26, 4	19.38	74.88	27, 4	17.45	74.71	28, 4	15.51	74.56
25, 5	21.50	72.93	26, 5	19.55	72.76	27, 5	17.60	72.61	28, 5	15.64	72.48
25, 6	21.65	70.78	26, 6	19.69	70.64	27, 6	17.72	70.52	28, 6	15.75	70.41
25, 7	21.78	68.64	26, 7	19.80	68.52	27, 7	17.82	68.42	28, 7	15.84	68.33
25, 8	21.87	66.48	26, 8	19.89	66.40	27, 8	17.90	66.32	28, 8	15.91	66.26
25, 9	21.95	64.33	26, 9	19.95	64.27	27, 9	17.96	64.22	28, 9	15.96	64.18
25, 10	21.99	62.17	26, 10	19.99	62.15	27, 10	17.99	62.12	28, 10	15.99	62.10
25, 11	22.00	60.02	26, 11	20.00	60.02	27, 11	18.00	60.02	28, 11	16.00	60.02
25, 12	21.99	57.86	26, 12	19.99	57.89	27, 12	17.99	57.92	28, 12	15.99	57.94
25, 13	21.95	55.71	26, 13	19.95	55.76	27, 13	17.96	55.81	28, 13	15.96	55.86
25, 14	21.88	53.55	26, 14	19.89	53.64	27, 14	17.90	53.71	28, 14	15.91	53.78
25, 15	21.78	51.40	26, 15	19.80	51.51	27, 15	17.82	51.61	28, 15	15.84	51.70
25, 16	21.65	49.25	26, 16	19.69	49.39	27, 16	17.72	49.52	28, 16	15.75	49.63
25, 17	21.50	47.11	26, 17	19.55	47.27	27, 17	17.60	47.42	28, 17	15.65	47.55
25, 18	21.32	44.97	26, 18	19.39	45.16	27, 18	17.45	45.33	28, 18	15.52	45.48
25, 19	21.11	42.84	26, 19	19.20	43.05	27, 19	17.29	43.24	28, 19	15.37	43.41
25, 20	20.88	40.71	26, 20	18.99	40.95	27, 20	17.10	41.16	28, 20	15.20	41.34
25, 21	20.62	38.59	26, 21	18.75	38.85	27, 21	16.89	39.08	28, 21	15.02	39.28
25, 22	20.33	36.48	26, 22	18.49	36.76	27, 22	16.65	37.00	28, 22	14.81	37.22
25, 23	20.02	34.37	26, 23	18.21	34.67	27, 23	16.40	34.94	28, 23	14.59	35.17
25, 24	19.68	32.28	26, 24	17.91	32.59	27, 24	16.13	32.87	28, 24	14.35	33.12
25, 25	19.32	30.19	26, 25	17.58	30.52	27, 25	15.84	30.81	28, 25	14.09	31.07
25, 26	18.94	28.11	26, 26	17.24	28.46	27, 26	15.53	28.76	28, 26	13.82	29.03
25, 27	18.53	26.05	26, 27	16.87	26.40	27, 27	15.20	26.72	28, 27	13.52	27.00
25, 28	18.10	23.99	26, 28	16.48	24.35	27, 28	14.85	24.68	28, 28	13.22	24.97
25, 29	17.65	21.94	26, 29	16.07	22.31	27, 29	14.48	22.65	28, 29	12.89	22.94
25, 30	17.18	19.91	26, 30	15.64	20.28	27, 30	14.10	20.62	28, 30	12.55	20.92
25, 31	16.68	17.88	26, 31	15.20	18.26	27, 31	13.70	18.60	28, 31	12.20	18.91

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
29, 1	13.14	80.58	30, 1	11.27	80.42	31, 1	9.39	80.30
29, 2	13.30	78.53	30, 2	11.41	78.39	31, 2	9.51	78.27
29, 3	13.45	76.48	30, 3	11.53	76.35	31, 3	9.61	76.25
29, 4	13.58	74.43	30, 4	11.64	74.31	31, 4	9.70	74.22
29, 5	13.69	72.37	30, 5	11.74	72.28	31, 5	9.78	72.19
29, 6	13.79	70.32	30, 6	11.82	70.23	31, 6	9.85	70.17
29, 7	13.86	68.26	30, 7	11.89	68.19	31, 7	9.91	68.14
29, 8	13.93	66.20	30, 8	11.94	66.15	31, 8	9.95	66.11
29, 9	13.97	64.14	30, 9	11.97	64.11	31, 9	9.98	64.08
29, 10	14.00	62.08	30, 10	12.00	62.06	31, 10	10.00	62.05
29, 11	14.00	60.02	30, 11	12.00	60.02	31, 11	10.00	60.02
29, 12	14.00	57.96	30, 12	12.00	57.97	31, 12	10.00	57.99
29, 13	13.97	55.90	30, 13	11.97	55.93	31, 13	9.98	55.96
29, 14	13.93	53.84	30, 14	11.94	53.89	31, 14	9.95	53.93
29, 15	13.87	51.78	30, 15	11.89	51.84	31, 15	9.91	51.90
29, 16	13.79	49.72	30, 16	11.82	49.80	31, 16	9.85	49.87
29, 17	13.69	47.66	30, 17	11.74	47.76	31, 17	9.78	47.84
29, 18	13.58	45.61	30, 18	11.64	45.72	31, 18	9.71	45.81
29, 19	13.45	43.56	30, 19	11.53	43.68	31, 19	9.61	43.79
29, 20	13.31	41.51	30, 20	11.41	41.65	31, 20	9.51	41.76
29, 21	13.15	39.46	30, 21	11.27	39.61	31, 21	9.40	39.74
29, 22	12.97	37.41	30, 22	11.12	37.58	31, 22	9.27	37.71
29, 23	12.77	35.37	30, 23	10.95	35.55	31, 23	9.13	35.69
29, 24	12.56	33.33	30, 24	10.78	33.52	31, 24	8.98	33.67
29, 25	12.34	31.30	30, 25	10.58	31.49	31, 25	8.83	31.66
29, 26	12.10	29.27	30, 26	10.38	29.47	31, 26	8.66	29.64
29, 27	11.85	27.24	30, 27	10.16	27.45	31, 27	8.47	27.63
29, 28	11.58	25.22	30, 28	9.93	25.43	31, 28	8.28	25.62
29, 29	11.29	23.20	30, 29	9.69	23.42	31, 29	8.08	23.61
29, 30	11.00	21.18	30, 30	9.44	21.41	31, 30	7.87	21.60
29, 31	10.69	19.17	30, 31	9.17	19.40	31, 31	7.65	19.59

Table 1 (Continued)

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
13, 1	42.52	87.67	14, 1	40.74	86.85	15, 1	38.95	86.11	16, 1	37.15	85.43
13, 2	43.16	85.08	14, 2	41.34	84.33	15, 2	39.52	83.63	16, 2	37.68	83.00
13, 3	43.74	82.45	14, 3	41.89	81.75	15, 3	40.03	81.12	16, 3	38.16	80.54
13, 4	44.26	79.76	14, 4	42.37	79.14	15, 4	40.48	78.56	16, 4	38.58	78.05
13, 5	44.71	77.03	14, 5	42.80	76.48	15, 5	40.88	75.98	16, 5	38.95	75.53
13, 6	45.10	74.26	14, 6	43.16	73.79	15, 6	41.22	73.37	16, 6	39.27	72.98
13, 7	45.42	71.46	14, 7	43.46	71.08	15, 7	41.50	70.73	16, 7	39.53	70.42
13, 8	45.67	68.63	14, 8	43.69	68.33	15, 8	41.72	68.07	16, 8	39.73	67.83
13, 9	45.85	65.77	14, 9	43.86	65.57	15, 9	41.87	65.40	16, 9	39.88	65.24
13, 10	45.96	62.90	14, 10	43.96	62.80	15, 10	41.97	62.71	16, 10	39.97	62.63
13, 11	46.00	60.02	14, 11	44.00	60.02	15, 11	42.00	60.02	16, 11	40.00	60.02
13, 12	45.96	57.15	14, 12	43.97	57.24	15, 12	41.97	57.33	16, 12	39.97	57.41
13, 13	45.85	54.28	14, 13	43.86	54.47	15, 13	41.87	54.65	16, 13	39.88	54.81
13, 14	45.68	51.42	14, 14	43.70	51.71	15, 14	41.72	51.97	16, 14	39.74	52.21
13, 15	45.43	48.59	14, 15	43.46	48.97	15, 15	41.50	49.32	16, 15	39.53	49.63
13, 16	45.11	45.78	14, 16	43.17	46.25	15, 16	41.22	46.68	16, 16	39.28	47.06
13, 17	44.72	43.01	14, 17	42.81	43.56	15, 17	40.88	44.06	16, 17	38.96	44.52
13, 18	44.27	40.28	14, 18	42.38	40.91	15, 18	40.49	41.48	16, 18	38.59	42.00
13, 19	43.75	37.60	14, 19	41.90	38.29	15, 19	40.04	38.93	16, 19	38.17	39.50
13, 20	43.17	34.96	14, 20	41.35	35.72	15, 20	39.53	36.41	16, 20	37.69	37.04
13, 21	42.53	32.37	14, 21	40.76	33.19	15, 21	38.96	33.93	16, 21	37.16	34.61
13, 22	41.84	29.84	14, 22	40.10	30.71	15, 22	38.35	31.49	16, 22	36.59	32.22
13, 23	41.09	27.37	14, 23	39.40	28.27	15, 23	37.69	29.10	16, 23	35.97	29.86
13, 24	40.29	24.95	14, 24	38.64	25.89	15, 24	36.98	26.75	16, 24	35.30	27.54
13, 25	39.44	22.60	14, 25	37.84	23.56	15, 25	36.22	24.44	16, 25	34.59	25.26
13, 26	38.54	20.30	14, 26	36.99	21.28	15, 26	35.42	22.18	16, 26	33.83	23.02
13, 27	37.60	18.05	14, 27	36.10	19.05	15, 27	34.58	19.97	16, 27	33.04	20.82
13, 28	36.62	15.87	14, 28	35.17	16.87	15, 28	33.70	17.80	16, 28	32.21	18.66
13, 29	35.60	13.74	14, 29	34.20	14.74	15, 29	32.78	15.67	16, 29	31.34	16.54
13, 30	34.54	11.67	14, 30	33.20	12.66	15, 30	31.83	13.59	16, 30	30.44	14.46
13, 31	33.45	9.65	14, 31	32.16	10.63	15, 31	30.85	11.55	16, 31	29.51	12.42

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
17, 1	35.34	84.81	18, 1	33.52	84.24	19, 1	31.70	83.72	20, 1	29.86	83.24
17, 2	35.84	82.42	18, 2	33.98	81.90	19, 2	32.13	81.42	20, 2	30.26	80.98
17, 3	36.28	80.01	18, 3	34.40	79.53	19, 3	32.51	79.10	20, 3	30.62	78.70
17, 4	36.68	77.57	18, 4	34.77	77.15	19, 4	32.86	76.76	20, 4	30.94	76.40
17, 5	37.03	75.11	18, 5	35.09	74.74	19, 5	33.16	74.40	20, 5	31.22	74.09
17, 6	37.32	72.63	18, 6	35.37	72.31	19, 6	33.41	72.03	20, 6	31.46	71.76
17, 7	37.56	70.13	18, 7	35.59	69.87	19, 7	33.62	69.64	20, 7	31.65	69.43
17, 8	37.75	67.62	18, 8	35.77	67.42	19, 8	33.79	67.24	20, 8	31.80	67.08
17, 9	37.89	65.09	18, 9	35.90	64.96	19, 9	33.91	64.84	20, 9	31.91	64.73
17, 10	37.97	62.56	18, 10	35.97	62.49	19, 10	33.98	62.43	20, 10	31.98	62.38
17, 11	38.00	60.02	18, 11	36.00	60.02	19, 11	34.00	60.02	20, 11	32.00	60.02
17, 12	37.97	57.48	18, 12	35.97	57.55	19, 12	33.98	57.61	20, 12	31.98	57.66
17, 13	37.89	54.95	18, 13	35.90	55.08	19, 13	33.91	55.20	20, 13	31.91	55.31
17, 14	37.76	52.43	18, 14	35.77	52.62	19, 14	33.79	52.80	20, 14	31.81	52.96
17, 15	37.57	49.91	18, 15	35.60	50.17	19, 15	33.63	50.40	20, 15	31.65	50.61
17, 16	37.32	47.41	18, 16	35.37	47.73	19, 16	33.42	48.02	20, 16	31.46	48.28
17, 17	37.03	44.93	18, 17	35.10	45.30	19, 17	33.16	45.64	20, 17	31.22	45.95
17, 18	36.69	42.47	18, 18	34.78	42.90	19, 18	32.86	43.28	20, 18	30.95	43.64
17, 19	36.29	40.03	18, 19	34.41	40.51	19, 19	32.52	40.94	20, 19	30.63	41.34
17, 20	35.84	37.62	18, 20	33.99	38.14	19, 20	32.13	38.62	20, 20	30.27	39.06
17, 21	35.35	35.23	18, 21	33.53	35.80	19, 21	31.70	36.32	20, 21	29.87	36.79
17, 22	34.81	32.88	18, 22	33.03	33.49	19, 22	31.24	34.04	20, 22	29.43	34.55
17, 23	34.23	30.56	18, 23	32.48	31.20	19, 23	30.73	31.79	20, 23	28.96	32.32
17, 24	33.60	28.27	18, 24	31.90	28.94	19, 24	30.18	29.56	20, 24	28.45	30.12
17, 25	32.94	26.02	18, 25	31.27	26.71	19, 25	29.59	27.35	20, 25	27.90	27.94
17, 26	32.23	23.80	18, 26	30.61	24.51	19, 26	28.97	25.17	20, 26	27.32	25.78
17, 27	31.48	21.61	18, 27	29.91	22.34	19, 27	28.32	23.02	20, 27	26.71	23.64
17, 28	30.70	19.46	18, 28	29.17	20.21	19, 28	27.63	20.89	20, 28	26.07	21.53
17, 29	29.88	17.35	18, 29	28.40	18.10	19, 29	26.91	18.79	20, 29	25.39	19.44
17, 30	29.03	15.27	18, 30	27.60	16.02	19, 30	26.15	16.72	20, 30	24.69	17.37
17, 31	28.15	13.23	18, 31	26.77	13.98	19, 31	25.37	14.68	20, 31	23.96	15.33

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
21, 1	28.02	82.81	22, 1	26.18	82.42	23, 1	24.33	82.06	24, 1	22.47	81.74
21, 2	28.39	80.58	22, 2	26.52	80.22	23, 2	24.64	79.89	24, 2	22.76	79.59
21, 3	28.73	78.34	22, 3	26.83	78.01	23, 3	24.92	77.71	24, 3	23.02	77.44
21, 4	29.02	76.08	22, 4	27.10	75.78	23, 4	25.17	75.52	24, 4	23.24	75.28
21, 5	29.28	73.81	22, 5	27.34	73.55	23, 5	25.39	73.32	24, 5	23.44	73.11
21, 6	29.50	71.53	22, 6	27.54	71.31	23, 6	25.58	71.12	24, 6	23.61	70.94
21, 7	29.68	69.24	22, 7	27.70	69.06	23, 7	25.73	68.90	24, 7	23.75	68.76
21, 8	29.82	66.94	22, 8	27.83	66.81	23, 8	25.85	66.69	24, 8	23.86	66.58
21, 9	29.92	64.64	22, 9	27.93	64.55	23, 9	25.93	64.47	24, 9	23.94	64.39
21, 10	29.98	62.33	22, 10	27.98	62.28	23, 10	25.98	62.24	24, 10	23.99	62.21
21, 11	30.00	60.02	22, 11	28.00	60.02	23, 11	26.00	60.02	24, 11	24.00	60.02
21, 12	29.98	57.71	22, 12	27.98	57.75	23, 12	25.98	57.79	24, 12	23.99	57.83
21, 13	29.92	55.40	22, 13	27.93	55.49	23, 13	25.93	55.57	24, 13	23.94	55.64
21, 14	29.82	53.10	22, 14	27.86	53.23	23, 14	25.85	53.35	24, 14	23.86	53.45
21, 15	29.68	50.80	22, 15	27.71	50.98	23, 15	25.73	51.13	24, 15	23.76	51.27
21, 16	29.50	48.51	22, 16	27.54	48.73	23, 16	25.58	48.92	24, 16	23.62	49.10
21, 17	29.28	46.23	22, 17	27.36	46.49	23, 17	25.39	46.72	24, 17	23.45	46.92
21, 18	29.03	43.96	22, 18	27.10	44.25	23, 18	25.18	44.52	24, 18	23.25	44.76
21, 19	28.73	41.70	22, 19	26.83	42.03	23, 19	24.93	42.33	24, 19	23.02	42.60
21, 20	28.40	39.46	22, 20	26.52	39.82	23, 20	24.64	40.15	24, 20	22.76	40.44
21, 21	28.03	37.23	22, 21	26.18	37.62	23, 21	24.33	37.98	24, 21	22.48	38.30
21, 22	27.62	35.01	22, 22	25.81	35.43	23, 22	23.99	35.82	24, 22	22.16	36.16
21, 23	27.18	32.82	22, 23	25.40	33.26	23, 23	23.61	33.67	24, 23	21.82	34.04
21, 24	26.71	30.64	22, 24	24.96	31.11	23, 24	23.21	31.54	24, 24	21.45	31.93
21, 25	26.20	28.48	22, 25	24.50	28.97	23, 25	22.78	29.42	24, 25	21.05	29.82
21, 26	25.67	26.33	22, 26	24.00	26.84	23, 26	22.32	27.31	24, 26	20.63	27.73
21, 27	25.10	24.21	22, 27	23.47	24.74	23, 27	21.83	25.22	24, 27	20.18	25.65
21, 28	24.50	22.11	22, 28	22.91	22.65	23, 28	21.32	23.14	24, 28	19.71	23.58
21, 29	23.87	20.03	22, 29	22.33	20.57	23, 29	20.78	21.07	24, 29	19.22	21.53
21, 30	23.21	17.97	22, 30	21.72	18.52	23, 30	20.22	19.03	24, 30	18.70	19.49
21, 31	22.53	15.93	22, 31	21.09	16.48	23, 31	19.63	16.99	24, 31	18.16	17.46

(Continued)

Table 1

Atlantic Phase I SOG Latitude - Longitude Coordinates*

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
1, 1	62.00	106.79	2, 1	60.59	104.19	3, 1	59.13	101.84	4, 1	57.62	99.72
1, 2	63.33	103.55	2, 2	61.85	100.95	3, 2	60.31	98.64	4, 2	58.73	96.56
1, 3	64.58	99.99	2, 3	63.02	97.45	3, 3	61.41	95.20	4, 3	59.75	93.21
1, 4	65.74	96.11	2, 4	64.10	93.67	3, 4	62.41	91.53	4, 4	60.69	89.65
1, 5	66.79	91.88	2, 5	65.07	89.60	3, 5	63.32	87.62	4, 5	61.53	85.89
1, 6	67.72	87.30	2, 6	65.93	85.23	3, 6	64.10	83.46	4, 6	62.26	81.94
1, 7	68.51	82.37	2, 7	66.65	80.60	3, 7	64.77	79.09	4, 7	62.87	77.81
1, 8	69.14	77.12	2, 8	67.23	75.71	3, 8	65.30	74.52	4, 8	63.36	73.51
1, 9	69.61	71.60	2, 9	67.65	70.61	3, 9	65.68	69.79	4, 9	63.71	69.10
1, 10	69.90	65.88	2, 10	67.91	65.37	3, 10	65.91	64.95	4, 10	63.92	64.59
1, 11	69.99	60.05	2, 11	67.99	60.05	3, 11	65.99	60.04	4, 11	63.99	60.04
1, 12	69.90	54.22	2, 12	67.91	54.72	3, 12	65.92	55.14	4, 12	63.92	55.49
1, 13	69.62	48.50	2, 13	67.65	49.48	3, 13	65.69	50.29	4, 13	63.71	50.98
1, 14	69.15	42.97	2, 14	67.23	44.38	3, 14	65.30	45.56	4, 14	63.36	46.56
1, 15	68.52	37.72	2, 15	66.66	39.48	3, 15	64.78	40.98	4, 15	62.88	42.27
1, 16	67.73	32.78	2, 16	65.94	34.84	3, 16	64.12	36.61	4, 16	62.27	38.13
1, 17	66.81	28.19	2, 17	65.09	30.48	3, 17	63.33	32.45	4, 17	61.54	34.17
1, 18	65.76	23.96	2, 18	64.12	26.40	3, 18	62.43	28.53	4, 18	60.71	30.41
1, 19	64.60	20.07	2, 19	63.04	22.61	3, 19	61.43	24.86	4, 19	59.77	26.85
1, 20	63.35	16.51	2, 20	61.87	19.10	3, 20	60.33	21.42	4, 20	58.74	23.49
1, 21	62.02	13.26	2, 21	60.62	15.87	3, 21	59.15	18.21	4, 21	57.64	20.34
1, 22	60.62	10.29	2, 22	59.29	12.87	3, 22	57.90	15.23	4, 22	56.45	17.37
1, 23	59.16	7.57	2, 23	57.90	10.11	3, 23	56.58	12.45	4, 23	55.20	14.59
1, 24	57.64	5.07	2, 24	56.46	7.56	3, 24	55.21	9.86	4, 24	53.90	11.98
1, 25	56.08	2.78	2, 25	54.96	5.20	3, 25	53.78	7.45	4, 25	52.53	9.54
1, 26	54.48	0.67	2, 26	53.43	3.01	3, 26	52.31	5.20	4, 26	51.13	7.24
1, 27	52.85	-1.28	2, 27	51.86	0.97	3, 27	50.80	3.09	4, 27	49.67	5.08
1, 28	51.19	-3.08	2, 28	50.25	-0.93	3, 28	49.25	1.12	4, 28	48.19	3.05
1, 29	49.50	-4.77	2, 29	48.62	-2.70	3, 29	47.67	-0.73	4, 29	46.66	1.13
1, 30	47.79	-6.33	2, 30	46.96	-4.36	3, 30	46.06	-2.47	4, 30	45.11	-0.68
1, 31	46.06	-7.80	2, 31	45.27	-5.92	3, 31	44.43	-4.11	4, 31	43.53	-2.39

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
5, 1	56.06	97.80	6, 1	54.46	96.07	7, 1	52.83	94.50	8, 1	51.16	93.08
5, 2	57.10	94.70	6, 2	55.44	93.03	7, 2	53.75	91.53	8, 2	52.03	90.18
5, 3	58.06	91.43	6, 3	56.34	89.85	7, 3	54.60	88.44	8, 3	52.83	87.17
5, 4	58.94	87.99	6, 4	57.16	86.52	7, 4	55.36	85.22	8, 4	53.54	84.05
5, 5	59.72	84.38	6, 5	57.89	83.05	7, 5	56.04	81.88	8, 5	54.18	80.83
5, 6	60.40	80.61	6, 6	58.52	79.45	7, 6	56.62	78.43	8, 6	54.72	77.52
5, 7	60.96	76.69	6, 7	59.04	75.73	7, 7	57.11	74.88	8, 7	55.17	74.13
5, 8	61.41	72.65	6, 8	59.45	71.90	7, 8	57.49	71.25	8, 8	55.53	70.67
5, 9	61.73	68.50	6, 9	59.75	67.99	7, 9	57.77	67.55	8, 9	55.79	67.16
5, 10	61.93	64.29	6, 10	59.93	64.03	7, 10	57.94	63.80	8, 10	55.94	63.60
5, 11	61.99	60.04	6, 11	60.00	60.03	7, 11	58.00	60.03	8, 11	56.00	60.03
5, 12	61.93	55.78	6, 12	59.94	56.04	7, 12	57.94	56.26	8, 12	55.95	56.46
5, 13	61.74	51.57	6, 13	59.76	52.07	7, 13	57.77	52.52	8, 13	55.79	52.90
5, 14	61.41	47.42	6, 14	59.46	48.17	7, 14	57.50	48.82	8, 14	55.54	49.39
5, 15	60.97	43.37	6, 15	59.05	44.34	7, 15	57.12	45.18	8, 15	55.18	45.93
5, 16	60.41	39.45	6, 16	58.53	40.61	7, 16	56.63	41.63	8, 16	54.73	42.53
5, 17	59.73	35.68	6, 17	57.90	37.01	7, 17	56.05	38.18	8, 17	54.19	39.22
5, 18	58.95	32.07	6, 18	57.18	33.53	7, 18	55.37	34.84	8, 18	53.56	36.00
5, 19	58.08	28.62	6, 19	56.36	30.20	7, 19	54.61	31.62	8, 19	52.84	32.89
5, 20	57.12	25.35	6, 20	55.46	27.02	7, 20	53.76	28.52	8, 20	52.05	29.87
5, 21	56.08	22.25	6, 21	54.48	23.98	7, 21	52.84	25.55	8, 21	51.18	26.97
5, 22	54.96	19.32	6, 22	53.42	21.09	7, 22	51.85	22.71	8, 22	50.24	24.18
5, 23	53.78	16.55	6, 23	52.30	18.35	7, 23	50.79	20.00	8, 23	49.24	21.50
5, 24	52.53	13.94	6, 24	51.12	15.74	7, 24	49.67	17.40	8, 24	48.18	18.94
5, 25	51.23	11.47	6, 25	49.89	13.27	7, 25	48.50	14.93	8, 25	47.06	16.47
5, 26	49.89	9.15	6, 26	48.60	10.92	7, 26	47.27	12.58	8, 26	45.90	14.11
5, 27	48.50	6.95	6, 27	47.27	8.69	7, 27	46.00	10.33	8, 27	44.68	11.85
5, 28	47.07	4.87	6, 28	45.90	6.58	7, 28	44.69	8.18	8, 28	43.43	9.69
5, 29	45.60	2.90	6, 29	44.49	4.56	7, 29	43.33	6.13	8, 29	42.13	7.61
5, 30	44.10	1.03	6, 30	43.05	2.64	7, 30	41.95	4.17	8, 30	40.80	5.62
5, 31	42.58	-0.75	6, 31	41.58	0.82	7, 31	40.53	2.30	8, 31	39.44	3.71

SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W	SOG I-J	LAT(DEG) N	LON(DEG) W
9, 1	49.48	91.78	10, 1	47.76	90.61	11, 1	46.03	89.54	12, 1	44.29	88.56
9, 2	50.29	88.93	10, 2	48.53	87.84	11, 2	46.76	86.83	12, 2	44.97	85.92
9, 3	51.04	86.02	10, 3	49.24	84.99	11, 3	47.42	84.06	12, 3	45.58	83.21
9, 4	51.71	83.01	10, 4	49.86	82.07	11, 4	48.01	81.22	12, 4	46.14	80.46
9, 5	52.30	79.90	10, 5	50.42	79.07	11, 5	48.52	78.32	12, 5	46.62	77.64
9, 6	52.81	76.72	10, 6	50.89	76.00	11, 6	48.97	75.36	12, 6	47.04	74.78
9, 7	53.23	73.47	10, 7	51.29	72.88	11, 7	49.33	72.36	12, 7	47.38	71.88
9, 8	53.56	70.16	10, 8	51.59	69.71	11, 8	49.62	69.31	12, 8	47.65	68.95
9, 9	53.80	66.81	10, 9	51.82	66.51	11, 9	49.83	66.23	12, 9	47.84	65.99
9, 10	53.95	63.43	10, 10	51.95	63.27	11, 10	49.95	63.14	12, 10	47.96	63.01
9, 11	54.00	60.03	10, 11	52.00	60.03	11, 11	50.00	60.03	12, 11	48.00	60.03
9, 12	53.95	56.63	10, 12	51.95	56.78	11, 12	49.96	56.92	12, 12	47.96	57.04
9, 13	53.81	53.25	10, 13	51.82	53.55	11, 13	49.83	53.82	12, 13	47.84	54.06
9, 14	53.57	49.89	10, 14	51.60	50.34	11, 14	49.63	50.74	12, 14	47.65	51.10
9, 15	53.24	46.58	10, 15	51.29	47.17	11, 15	49.34	47.70	12, 15	47.38	48.17
9, 16	52.82	43.33	10, 16	50.90	44.05	11, 16	48.97	44.69	12, 16	47.04	45.27
9, 17	52.31	40.15	10, 17	50.43	40.98	11, 17	48.53	41.73	12, 17	46.63	42.41
9, 18	51.72	37.05	10, 18	49.87	37.98	11, 18	48.02	38.83	12, 18	46.15	39.59
9, 19	51.05	34.03	10, 19	49.25	35.06	11, 19	47.43	35.99	12, 19	45.59	36.83
9, 20	50.31	31.10	10, 20	48.55	32.21	11, 20	46.77	33.	12, 20	44.98	34.13
9, 21	49.49	28.26	10, 21	47.78	29.44	11, 21	46.05	30..1	12, 21	44.30	31.48
9, 22	48.61	25.53	10, 22	46.95	26.76	11, 22	45.26	27.88	12, 22	43.56	28.90
9, 23	47.66	22.89	10, 23	46.05	24.16	11, 23	44.42	25.32	12, 23	42.76	23.39
9, 24	46.66	20.34	10, 24	45.10	21.64	11, 24	43.52	22.84	12, 24	41.92	23.94
9, 25	45.60	17.90	10, 25	44.10	19.21	11, 25	42.57	20.43	12, 25	41.02	21.56
9, 26	44.49	15.54	10, 26	43.04	16.87	11, 26	41.57	18.10	12, 26	40.07	19.24
9, 27	43.33	13.28	10, 27	41.94	14.60	11, 27	40.52	15.84	12, 27	39.08	16.99
9, 28	42.13	11.10	10, 28	40.80	12.42	11, 28	39.44	13.65	12, 28	38.04	14.80
9, 29	40.90	9.00	10, 29	39.62	10.30	11, 29	38.31	11.53	12, 29	36.97	12.67
9, 30	39.62	6.98	10, 30	38.40	8.23	11, 30	37.14	9.47	12, 30	35.86	10.60
9, 31	38.31	5.04	10, 31	37.15	6.29	11, 31	35.95	7.48	12, 31	34.71	8.60

(Continued)

* NEGATIVE VALUES INDICATE EAST LONGITUDES.

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PART IX: SUMMARY

33. The objective of ACWIS was to provide the US Army Engineers (USAE) with hindcast wave and water level information for the US Atlantic coast. This report shows that additional valuable information has been produced as part of the WIS working toward its goal. The procedures used and the data produced have been presented previously in several WIS reports. Since many of the details of the data processing for the WIS are not included in this summary report, reports listed in the references and bibliography should be reviewed for a more complete understanding of the WIS. The ACWIS has produced and archived extensive surface pressure data and open-ocean wind data as well as hindcast wave and water level information. All data produced by the ACWIS are summarized in Table 7.

34. In addition to WIS data reports (Corson et al. 1981, Corson et al. 1982, Ebersole 1982, and Jensen 1983a), the Atlantic hindcast wave data have been archived for the USAE on the computer-based data system. SEAS has been updated with deepwater wave data from the Pacific Ocean and in the near future will be extended to include shallow-water wave transformations.

Table 5 (Continued)

Station Number	Latitude	Longitude	Shoreline Angle	Description
85	35.66°	75.48°	2°	~3.5 nautical miles north of Rodanthe (Hatteras Island), North Carolina
86	35.49°	75.48°	12°	~3 nautical miles south of Salvo (Hatteras Island), North Carolina
87	35.32°	75.51°	8°	~2 nautical miles south of Avon (Hatteras Island), North Carolina
88	35.25°	75.48°	76°	Tip of Cape Hatteras to ~8 nautical miles west southwest of Cape
89	35.22°	75.66°	68°	~7 nautical miles southwest of Cape Hatteras (Hatteras Island), North Carolina
90	35.15°	75.85°	54°	~4 nautical miles south of Hatteras Inlet (Ocracoke Island), North Carolina
91	35.07°	76.00°	52°	Ocracoke, North Carolina
92	34.97°	76.16°	48°	Portsmouth Island, North Carolina
93	34.86°	76.30°	43°	~1 nautical mile north of Drum Inlet, North Carolina
94	34.74°	76.43°	34°	Core Banks, North Carolina
95	34.59°	76.54°	121°	Cape Lookout, North Carolina
96	34.68°	76.70°	87°	~1 nautical mile south of Beaufort Inlet, North Carolina
97	34.68°	76.90°	75°	Bogue Banks, North Carolina
98	34.64°	77.09°	64°	~1/2 nautical mile north of Bogue Inlet, North Carolina
99	34.57°	77.27°	56°	Onslow Beach, North Carolina
100	34.48°	77.44°	54°	Sea Haven Beach, North Carolina
101	34.38°	77.61°	44°	Topsail Beach, North Carolina
102	34.23°	77.75°	29°	Figure Eight Island, North Carolina
103	34.12°	77.85°	20°	~2.5 nautical miles north of Carolina Beach Inlet, North Carolina
104	33.96°	77.92°	19°	Kure Beach, North Carolina
105	33.85°	77.17°	118°	Tip of Cape Fear to ~8 nautical miles east northeast of Cape
106	33.91°	78.11°	90°	~5.5 nautical miles west of Cape Fear River Entrance, North Carolina
107	33.91°	78.31°	74°	Holden Beach, North Carolina
108	33.87°	78.50°	70°	Sunset Beach, North Carolina
109	33.81°	78.69°	56°	Crescent Beach, South Carolina
110	33.71°	78.85°	41°	Myrtle Beach, South Carolina
111	33.59°	78.99°	37°	Surfside Beach, South Carolina
112	33.45°	79.10°	20°	Litchfield Beach, South Carolina
113	33.30°	79.17°	17°	North Island, South Carolina
114	33.14°	79.24°	36°	Santee Point, South Carolina
115	33.00°	79.36°	65°	Cape Romain, South Carolina
116	32.92°	79.58°	50°	Bull Island, South Carolina
117	32.81°	79.72°	53°	Isle of Palms, South Carolina
118	32.71°	79.88°	45°	Morris Island (~2 nautical miles south of Charleston Harbor), South Carolina
119	32.61°	80.04°	71°	Kiawah Island, South Carolina
120	32.56°	80.22°	49°	Botany Bay Island, South Carolina
121	32.39°	80.43°	48°	Hunting Island, South Carolina
122	32.27°	80.58°	49°	Bull Point at Port Royal Sound, South Carolina
123	32.16°	80.72°	34°	Hilton Head Island, South Carolina
124	32.02°	80.83°	37°	Tybee Island, Georgia
125	31.89°	80.96°	42°	Wassaw Island, Georgia
126	31.76°	81.09°	18°	Ossabaw Island, Georgia
127	31.60°	81.15°	25°	Saint Catherines Island, Georgia

(Continued)

Table 5 (Concluded)

Station Number	Latitude	Longitude	Shoreline Angle	Description
128	31.50°	81.23°	21°	Blackbeard Island, Georgia
129	31.29°	81.28°	24°	Little Saint Simons Island, Georgia
130	31.14°	81.38°	14°	Saint Simons Island, Georgia
131	30.98°	81.41°	9°	Little Cumberland Island, Georgia
132	30.81°	81.45°	357°	Cumberland Island, Georgia
133	30.64°	81.43°	352°	Fernandina Beach, Florida
134	30.48°	81.41°	350°	Little Talbot Island, Florida
135	30.31°	81.39°	348°	Jacksonville Beach, Florida
136	30.15°	81.35°	349°	Mickler Landing, Florida
137	29.99°	81.31°	344°	~5 nautical miles north of Saint Augustine, Florida
138	29.82°	81.26°	346°	Saint Augustine Beach, Florida
139	29.66°	81.21°	340°	~3 nautical miles south of Matanzas Inlet, Florida
140	29.51°	81.14°	338°	Flagler Beach, Florida
141	29.35°	81.07°	337°	Ormond Beach, Florida
142	29.20°	81.00°	334°	Seabreeze, Florida
143	29.05°	80.90°	331°	New Smyrna Beach, Florida
144	28.90°	80.81°	330°	Eldora, Florida
145	28.76°	80.71°	326°	Mosquito Lagoon Beach, Florida
146	28.62°	80.60°	337°	Titusville Beach, Florida
147	28.47°	80.53°	24°	Cape Canaveral, Florida
148	28.31°	80.61°	354°	Cocoa Beach, Florida
149	28.15°	80.58°	340°	Satellite Beach, Florida
150	27.99°	80.52°	334°	Melbourne Beach, Florida
151	27.85°	80.44°	337°	~1.5 nautical miles south of Sebastian Inlet, Florida
152	27.68	80.37°	337°	Riomar, Florida
153	27.52°	80.31°	339°	~3 nautical miles north of Fort Pierce Inlet, Florida
154	27.37°	80.25°	338°	Hutchinson Island, Florida
155	27.21°	80.17°	338°	~2.5 nautical miles north of Saint Lucie Inlet, Florida
156	27.06°	80.11°	342°	Jupiter Island, Florida
157	26.89°	80.06°	347°	~3 nautical miles south of Jupiter Inlet, Florida
158	26.73°	80.03°	1°	Palm Beach, Florida
159	26.56°	80.04°	12°	Delray Beach, Florida
160	26.39°	80.07°	7°	Boca Raton, Florida
161	26.23°	80.09°	8°	Pompano Beach, Florida
162	26.06°	80.11°	2°	Hollywood Beach, Florida
163	25.90°	80.12°	6°	Miami Beach, Florida
164	25.72°	80.15°	11°	Key Biscayne, Florida
165	25.52°	80.17°	18°	Boca Chita Key, Florida
166	25.37°	80.24°	40°	Old Rhodes Key, Florida

Table 6

National Ocean Service, East Coast Tidal Stations

Station No.	Station Name	Location		Data Available for Years
		Latitude North	Longitude West	
841-0140	Eastport, Maine	44°54.2'	66°59.1'	1940-1967
841-3320	Bar Harbor, Maine	44°23.5'	68°12.3'	1947-1967
841-8150	Portland, Maine	43°39.4'	70°14.8'	1940-1967
841-9870	Seavey Island, Maine	43°04.9'	70°44.7'	1940-1967
844-3970	Boston, Mass.	42°21.3'	71°03.0'	1936-1965
844-7930	Woods Hole, Mass.	41°31.5'	79°40.4'	1932-1964
845-2260	Newport, R. I.	41°48.4'	71°24.1'	1940-1966
846-1490	New London, Conn.	41°21.5'	72°05.5'	1938-1954
851-0560	Montauk Pt., N. Y.	41°02.9'	71°57.6'	1947-1967
851-6990	Willets Pt., N. Y.	40°47.6'	73°46.9'	1940-1967
851-8750	The Battery, N. Y.	40°42.0'	74°05.5'	1936-1968
853-1680	Sandy Hook, N. J.	40°28.0'	74°00.1'	1940-1967
853-4720	Atlantic City, N. J.	37°21.3'	74°25.1'	1955-1960 1971-1981
855-7380	Lewes, Del.	38°46.9'	75°07.2'	1950-1973
863-8610	Hampton Roads, Va.	38°56.8'	76°19.9'	1927-1971
865-9084	Southport, N. C.	33°54.9'	78°01.1'	1933-1954
866-5930	Charleston, S. C.	32°46.9'	79°55.5'	1940-1966
867-0870	Fort Pulaski, Ga.	32°02.0'	80°54.1'	1935-1967
872-0220	Mayport, Fla.	30°23.6'	81°25.9'	1940-1969
872-3170	Miami Beach, Fla.	25°46.1'	81°07.9'	1972-1981

Table 7

Summary of WIS Data for the Atlantic Coast

ACWIS Data Set	Period of Record	Time-Steps (GMT)	SOG or Stations	~ Spatial Separation	Data Status*	Archive Location**
Surface pressure fields	1956-1975	6-hr	61 by 61	110 km	P, A	WES
Phase I hindcast winds	1956-1975	3-hr	31 by 31	220 km	P, A	WES and NCDC
Phase II hindcast winds	1956-1975	3-hr	41 by 33	55 km	P, A	WES and NCDC
Phase I wave data	1956-1975	3-hr	31 by 31	220 km	P	
Sea and swell parameters	1956-1975	3-hr	13 sites	Variable	P, A	WES and NCDC
2-D spectra	1956-1975	3-hr	96 sites	Variable	U, A	WES
Phase II wave data	1956-1975	3-hr	41 by 33	55 km	P	
Sea and swell parameters	1956-1975	3-hr	73 sites	Variable	P, A	WES and NCDC
2-D spectra	1956-1975	3-hr	113 sites	Variable	U, A	WES
Phase III wave data	1956-1975	3-hr	166 sites	18.5 km	P, A	WES and NCDC
Water level data	1927-1981	1-hr	20 sites	Variable	P, A	WES

* P = processed; U = unprocessed; and A = archived.

** Persons interested in obtaining WIS data that have been transferred to NCDC should reference Tape Deck 9787. The mailing address for their customer service department is:

National Climatic Data Center
Attention: Customer Service
Federal Building
Asheville, North Carolina 28801

Telephone requests for data, followed by written requests for same, will also be accepted. The telephone numbers for NCDC's Customer Service Department are:

Commercial: (704) 259-0682 FTS: 672-0682
(704) 259-0683 672-0683

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